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EDITORIALS

AT THE HEART OF THE CANCER PROBLEM

PERHAPS no malady to which the flesh is heir has received more intensive study than has been accorded to cancer. Yet it is generally agreed that cancer, one of the chief destroyers of mankind, remains essentially a mystery. For while every conceivable cause has been investigated with immeasurable effort the true cause, or causes, are yet unknown. No specific treatment has been found. Against malignancy Medical Science can offer no immunity. And the only sure means for early diagnosis is the examination of an excised fragment of already cancerous tissue beneath the microscope. That such a state of affairs should exist despite the searching inquiries of the past and the elaborate researches of modern times has led many able thinkers and students of cancer to the pessimistic conclusion that "The various specific causes may *never* be known and no specific cure *ever* found." Cancer is a biologic process held to possess mysteries as deep and unfathomable as those of life itself.

But in contrast to this dark side of present day knowledge concerning neoplastic disease is the optimistic view that there already exist "enough known facts, if properly and intensively applied, to *solve* the cancer problem." It cannot be questioned that thousands of individuals with proved malignancy have been restored to health for periods of five, ten or more years through surgical or irradiation treatments, alone or in combination. Stressing "The Curability of Cancer" the American College of Surgeons in its symposia of 1932 and 1933 placed on record five year cures of no less than 24,448 cases. These definitive cures, reported by accepted authorities from all parts of the United States, encompass every major organ and tissue in the body.

Agreement is universal that for the attainment of such results diagnosis must be early and treatment both thorough and expert. These factors repeatedly have been emphasized as the *sine qua non* for further reductions in mortality rates. The British Ministry of Health in its Medical Report No. 34

(1926) on "The Late Results of Operation for Cancer of the Breast" demonstrates most graphically the importance of the time factor. In this survey on end-results from radical mastectomy the following conclusion is reached:

> The extreme importance of undertaking the complete operation while the growth is still confined to the breast is demonstrated; given these conditions it is rare for a patient to die of the disease within ten years of the operation. On the other hand it is the exception for one undergoing similar treatment after the growth has ceased to be local to be alive ten years after operation. Or, expressed in percentages we have:
>
> Class 1. (Growth limited to Breast) 90.1 per cent *alive* at ten years after operation.
>
> Class 2. (Axillary glands involved) 91.3% Dead within ten years after operation.
>
> Class 3. (Advanced cases) 94.4% dead within ten years.

The heart of the cancer problem today, then, is *early diagnosis followed by prompt and expert application of now known and well-established methods of treatment;* it is to secure for increasing numbers the benefits which already have been given to those authentically recorded as "cured," in brief, to attain the attainable. And to this practical, vital and immediate center of the problem—the center alike for the patient with malignant disease and for individual physician and surgeon—this symposium of The American Journal of Surgery is directed. It is the aim to concentrate at this focal point detailed descriptions by leading authorities from world cancer clinics of the technical procedures routinely employed and to lay before the reader precise accounts of those methods which have proved most effective in the management of the many and varied types of cancer. Every effort will be made to bring into the closest possible relationship those two great tools for the management of malignancy, surgery and irradiation, as in succeeding issues of the Journal region after region of the body is dealt with from the standpoints of surgical, electrosurgical and irradiation therapy.

The cancer problem as a whole involves three distinct and well-recognized phases as dependent upon one another as are the sides of a triangle: Cancer Education, Cancer Treatment and Cancer Research. But the basic reason cancer is a problem at all is its appalling cost to human life, hence the solution of the problem lies entirely with the elimination or minimization of this loss. Thus it is, that Cancer Education and Cancer Research both have treatment as their ultimate goal. The effectiveness of campaigns among the laity, as conducted by The American Society for the Control of Cancer, The American College of Surgeons and The American Medical Association, is directly proportional to the effectiveness of the treatment given. And the final meaning of investigation and research, likewise, must be weighed in terms of treatment and end-results. The highest reward to be gained from a study of the basic biologic nature of malignant disease and from that ceaseless search for an essential cause, would be the production of some form of active immunity; but until this goal is reached the attainments of research must rest with advancements in treatment of individual patients, either by newly developed forms of therapy or improvements in existing methods.

It is important that purely investigative studies should not dominate the literature of the practicing physician and surgeon nor mask the major issues of promptness in diagnosis and thoroughness in the application of present forms of treatment. While research efforts represent hopes for the future they can in no way be conceived as substantial groundwork upon which now to rely in cancer management. There is indeed positive danger in the inflicting of undue research upon present-day suffers, if this be conducted to the detriment of accepted methods of therapy. For example, to treat by means other than radical mastectomy cases of mammary

cancer apparently still confined to breast tissues is to abnegate the laborious work of our surgical forebears and the step by step progress which has lead to well-assured end-results with malignancy of this type. What could reasonably be asked beyond 90 per cent ten year cures? To search, through other measures, for a possible 92 or 94 per cent cure is to substitute hope for achievement. The years needed to test new therapeutic hypotheses, the small increment of possible gain, the overwhelming probabilities of loss, all argue conclusively against the inflicting of experimentation of this nature upon those individuals who come confidently seeking the best that science can offer and the safeguarding of their full chances for life.

And in this vastly important matter the individual surgeon plays a major rôle; for by radical mastectomy, to change the life outlook of even ten women with localized mammary cancer from an untreated expectancy of less than three years to a survival of ten years would mean a saving of seven years of life per patient, or a total of seventy years. In other words, any surgeon thus managing as few as ten patients of this type actually gives more life than has been given to himself. And this striking life saving may be secured with the low operative mortality of 1.5 to 3 per cent.

Dr. Franklin Martin has stated: "Even if only one half of the cancer cases could be diagnosed early and properly treated the mortality rate (in the United States and Canada) would be reduced by 25,000 per year." Thus, promptly and adequately to treat *by known methods* even one-half the sufferers from cancer would effect a saving far more than equal to the total elimination of deaths from appendicitis.

Estimating the possible saving on an economic basis the Health Commissioner for the state of Massachusetts (1932) states: "With this assumption of the net value of patients (Dublin figure for value of the average wage earner) that can be cured of cancer in Massachusetts *if our present knowledge and resources* are used to the best advantage, is slightly in excess of $3,600,000 per year." If the achievable saving per year in this one state were anything like such a figure the national economic significance of attaining the maximum from present-day methods is self evident.

There is no reason for the slightest diminution in the intensity of a campaign for a full and effective application of present-day treatment because the cause of cancer remains unknown; nor is there reasonable certainty that the battle against malignancy would be quickly won should a specific cause be identified. With tuberculosis and syphilis, for example, treatment is not directly dependent upon cause. The discovery of the tubercle bacillus (announced by Koch in March of 1882) has not resulted in the elaboration of any product used for cure. Such measures as rest, fresh air, hygiene, heliotherapy, pneumothorax, so long and successfully employed in the management of tuberculosis were worked out quite independently of a specific cause. And there is still no product of the Treponema pallidum (Schaudinn and Hoffman, 1905) used for the cure of syphilis.

The turning point in cancer results may rest more upon psychological factors, both lay and professional, than upon new discoveries. Such a viewpoint is strengthened by a study of the situation with regard to acute appendicitis thirty years ago. In 1900, in a certain large metropolitan hospital, there were performed but 14 operations for appendicitis, all for either appendicular abscess or generalized peritonitis and not in a single case for the early removal of an inflamed, non-perforated appendix. Yet the complete description of appendicitis and its treatment as even now employed had been published more than fifteen years before that time! In the same institution in 1924 there were *fourteen hundred* operations for appendicitis (actu-

ally 1393 with a 5.1 per cent mortality). It required more than two decades of professional and lay education and a completely changed psychological attitude towards the disease to reach accord concerning effective treatment; the reduction in mortality came, not through newer facts and additional methods, but simply from better diagnosis and agreement as to immediate operation. What would be the mortality rate at present if the surgical attack were still made only upon the late and neglected case? Time and again the profession has had this question to face: "Where will the 90 per cent rest, with the cures or with the deaths," and the answer has been dependent upon one point—time of treatment. With intestinal obstruction the mortality following early operation is from 10–30 per cent, while that following late operation is 70–100 per cent. Ninety per cent cures with perforated peptic ulcer come only from immediate operation, while 10 per cent cures would be a fortunate outcome in the face of long-established general peritonitis.

The more clearly there is perceived in cancer the operation of this inexorable law the more determined will be the effort for early diagnosis and the more insistent the study of all details of successful treatments. It is inestimably important whether cancer cures are to remain at the 5–15 per cent which represent the maxima throughout the body for "late" cases or to range from the 70–90 per cent cures as even now obtained in region after region where small, localized, and group 1 malignant growths have been accorded prompt and expert care.

Neither surgery nor irradiation is more than a palliative measure for late and generalized malignant disease. Metastasis is to cancer what gangrene of the bowel is to mechanical intestinal obstruction and what diffuse peritonitis is to perforated gastric ulcer or acute appendicitis. And if any single point concerning cancer has been established it is that cancer must not be allowed to disseminate; it must be treated by adequate attack while local, for cancer can be eradicated when local, but eradicated *only* when local.

In this symposium on "Present-Day Treatment of Malignant Disease," aimed at the heart of the cancer problem and planned as a summary of widely accepted methods of practical cancer therapy, both authors and readers will play an important rôle; the authors by the overwhelming weight of their authority and the readers by that intangible but all-powerful force—thought. But the greater rôle rests with the reader, for in the last analysis it is he who controls the destiny of the cancer patient.

Edward M. Livingston.

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CANCER OF THE RECTUM AND RECTOSIGMOID

So much confusion exists in the minds of the average practitioner that it is not surprising that the public are so easily duped by the various promises of cure. A man attacked by this insidious disease having a horror of the knife, eagerly grasps at any other relief that may be offered; and yet, it is in surgery, we believe, that the greatest hope of relief may be found.

With the family physician, into whose care the patient first comes, rests very grave responsibility. The future of this patient will depend upon the diagnosis and advice he gives. It is therefore his duty to keep well informed as to just what has been accomplished in the treatment of cancer; how this or that method has proved helpful or inadequate, that his patient may have intelligent instruction. And it is the duty of the specialist to inform the family physician, from time to time, what his results have been with the various remedies in vogue. It is only by the specialist's help that the family physician can form an intelligent perspective of the course to pursue.

Honesty of purpose must be the first consideration of us all.

That under the most favorable circumstances, results are often far from satisfactory, we all admit; our knowledge of cancer is still vague; but that the cancer patient must always enter on a one-way street, we deny.

After an experience of many years in meeting this malady, we believe that, taken in time, surgery is our most dependable aid. Mayo states that autopsy has shown 60 out of every 100 deaths from cancer of the colon, resulted from either obstruction, perforation or peritonitis.

In cancer of the sigmoid, so insidious is the onset of the disease, that the presence of the tumor is sometimes detected only at operation after rupture of the bowel.

The efficacy of a treatment can be proved only by results.

There are many instances recorded of patients living in comfort for from two to six years after a colostomy, and Mummery states that he has had several such instances in his practice.

Therefore, when anyone claims that he has patients living from three to five years after treatment by radium and *x*-ray, he should take into consideration what would have taken place if a simple colostomy had been performed, and all results must be comparatively considered in the light of colostomy. However, as far as we know there is no instance of a patient being free from trouble longer than six years due to any procedure other than surgery.

In short, the claims of radiation treatment of operable carcinoma of the rectum are not accepted at the present time as justifiable. While the mortality of the operation is considerable, the results are so satisfactory as regards permanent cure, and the returns from radiation so variable and incalculable, that there is no justification for the substitution of radiation or surgery, no matter how small the growth or how favorable the situation, despite the fact that a few cases of permanent cures, both by radium and *x*-ray, have been recorded by competent observers. But as the larger proportion of the cases of carcinoma of the rectum and lower sigmoid are quite inoperable at the time when the diagnosis can be made, the propriety of the application of radiation methods to such tumors is quite different from that in the operable variety.

There are, however, many questions in regards to the details of treatment for which satisfactory answers are not yet available, and it is at present impossible to draw up definite rules governing the individual case. One of these questions is whether in hopelessly inoperable cases of carcinoma of the rectum the expectation of life will be greater if a colostomy is done and the patient left with a permanent opening and without further treatment,

or whether something will be gained by active *x*-ray or radium treatment following the colostomy. The mere effect of the colostomy itself is to diminish infection and in a large number of cases to cause prolonged arrest of symptoms and an astonishing extension of life, far beyond that to be expected from growths in other situations.

Radiation has depressing sequelae, may be disastrous to the patient's appetite, and often exerts a destructive action on the blood-forming organs. There is not, moreover, sufficient statistical material available at present to form a basis of judgment as to whether the results are better after heavy radiation of a tumor following colostomy than leaving the patient alone.

The number of deaths from cancer of the colon and rectum are increasing. A high percentage of these cases are evading those fitted to treat them with courage and skill. There are three reasons for this:

1. A group of silent cancers which are hopeless when first recognized.

2. A group which *will not* seek competent medical advice until in a terminal state thereby furnishing the large general hospitals with the cases of malignant obstruction.

3. A group which falls into the hands of physicians who look on cancer as an act of God and are opposed to surgery.

In addition we may note with regret the cases who consult their physician early, are never given a complete searching examination, and are suddenly recognized when in extremes.

We must continue to repeat that two-thirds of the cancers of the *colon and rectum* are within the reach of the *proctoscope* and that nearly all *rectal cancers* are within the reach of the *finger*. Further) pain, diarrhea and colic are *not* the symptoms of cancer of the large bowel.

In the matter of surgical treatment the mind of every surgeon should be opened to the lessons of his experience.

The advocacy of the *clamp-resection* method is based on sound judgment and is a worthwhile application of the Paul-Mikulicz procedure.

The leanings of many surgeons towards operation in stages is warranted by the results. While not having personal experience of the peritoneal vaccination in preparation for operation, we have followed it with great interest. Personally, we are in favor of the one stage operation whenever feasible.

We would like to enter a plea for the limited amputation or perineal operation for certain cases of cancer of the rectum. We favor it for the low-lying apparently operable growth in the poor risk patient. There is no preliminary colostomy. The growth can be rapidly removed, the gut mobilized and fixed by a few sutures in the site of the anus. There is practically no shock, and surprisingly enough there is a remarkable freedom from bowel accidents. The operation is of course reserved for special cases.

As elsewhere, surgical procedures on the colon and rectum are, in the main, settled, the resection for neoplasm following well-defined lines and largely governed by the facts of blood supply, lymphatic drainage, the presence or absence of obstruction, infection or abscess formation. In the surgery of the large bowel, and especially of the left colon, the recognition and treatment of obstruction are of paramount importance. Following the establishment of external or internal drainage, when necessary, the rehabilitation of the patient is taken care of by fluids, glucose, non-residue diet and transfusions. Peritoneal vaccination may be considered advisable and causes little discomfort or danger. At exploration, the decision is made as to the extent of the procedure and the method to be adopted: resections with immediate restoration of the continuity of the gut as in the classic Friedreich's operation or the first stage of a clamp-resection of the type of Rankin-Mikulicz. No matter what the method employed, the principles of surgery of the large intestine remain: decompression, moblilization, scrupulous asepsis and resection according to the vascular pattern.

JEROME M. LYNCH, M.D.

SYPHILIS AND EDUCATION

THE duty of physicians in educating the people about syphilis is perhaps less evident than with any other disease. Syphilis in its own peculiar way is the most damaging disease of the human race. It has been the cause of more deaths and more family wrecking than any other plague of man.

At the present time it is impossible to lower the incidence of syphilis in highly civilized communities. The physician is at the end of his string. In the most highly moral and cleanly communities the incidence of syphilis reaches its low water mark at about 7 per cent. Among less civilized peoples the rate goes up enormously until among primitive peoples it becomes one of the exanthemata of childhood.

The two factors which have lowered its incidence are morality and personal cleanliness. If sex morality could be made perfect or if prophylaxis could be made perfect, syphilis would disappear from the earth within about three generations. We can hardly hope that either of these measures will ever be perfect so that the duty of the physician is evident. Since he cannot by professional means lower the incidence below a certain rate, it is apparent that a new principle will have to be evolved if the rate is to be further lowered, and that principle would seem to be the teaching of the mode of acquisition, the damage and the mode of prevention by popular means, that is to say, by the newspapers and the radio.

It is of no service to the people of the earth for doctors in their scientific discussions to tell each other how they can lower the rate of this terrible disease. They know that already, but it *is* necessary to get this knowledge to the people so that mothers and fathers may teach the family, which is the unit of government, what the human race has suffered from this disease.

When radio companies will shut off physicians as they have recently who were trying to get a message to the tax payers in regard to this matter, it shows the revolution that will have to take place before this subject can properly be handled. The pure artificiality of the position of the radio companies in refusing the microphones to health officers broadcasting educational material of this sort is shown when we recall the licentious matter that is broadcast directly and indirectly over the radio systems every day. These companies consider it perfectly legitimate to broadcast material about tuberculosis or typhoid fever or to advertise tooth paste, all of which are of much less importance to the family than is syphilis.

Legalization of the sale of alcohol has made popular education in sexual diseases all the more necessary. Resorts of all kinds know the importance of alcohol in breaking down the will power of both sexes. Some of the night clubs are perfect examples of the team work between alcohol and venery. Since the beginning of time Bacchus and Venus have danced together.

It would seem that the only way this problem can be solved is by the concerted action of the medical profession in prevailing upon newspapers and radio corporations to broadcast material of this character when it has the sanction of city, state or federal authority.

C. S. BUTLER.

PRESENT-DAY TREATMENT OF MALIGNANT TUMORS

EDITOR: EDWARD M. LIVINGSTON, M.D.

I. CANCER OF THE RECTUM AND RECTOSIGMOID
A SYMPOSIUM

THE TECHNIQUE OF ABDOMINOPERINEAL RESECTION FOR CARCINOMA OF THE RECTUM

THOMAS E. JONES, M.D.

CLEVELAND, OHIO

THE primary object of any operation for cancer of the rectum or rectosigmoid must be the eradication of the disease. The pathologic observation regarding the lymphatic spread which has been so well demonstrated by Miles makes it quite apparent that the combined abdominoperineal operation fulfils this purpose better than any other type of procedure so far devised.

Spinal anesthesia is preferable in performing this operation. Then the patient should be placed in the Trendelenburg position, which makes it easy to pack the intestines well out of the pelvis. This is an essential requirement because the operation necessitates deep pelvic dissection. A midline or left rectus incision is the next step and the liver is explored for metastasis. One nodule does not contraindicate operation. Multiple nodules do. The gland-bearing area is then examined, only, however, to note the extent of malignant invasion. Even extensive involvement of the nodes does not contraindicate operation. Finally the growth is inspected if it lies above the reflection of the pelvic peritoneum. If there are multiple small nodules on the peritoneum, operation is contraindicated unless the area which contains them can be resected widely.

If all these conditions favor going ahead with the operation, the sigmoid is then examined. Occasionally it is necessary to mobilize the sigmoid by cutting its peritoneal attachments on the lateral side (Fig. 1). The location of the inferior mesenteric artery is then determined and this vessel is ligated below the first sigmoid branch (Fig. 2). The Cameron light is very useful for this procedure unless the mesocolon is too thick. In the latter case the artery is exposed by incising the peritoneum of the mesentery about an inch below the bifurcation of the aorta. Ligation of this vessel insures a bloodless field for the pelvic dissection.

The succeeding step is incision of the peritoneum on each side of the mesosigmoid down to the promontory of the sacrum. These lateral incisions are continued down until they meet anteriorly behind the base of the bladder in the male or the pouch of Douglas in the female. (Figs. 3A, B, C.)

Traction on the bowel then brings into view the areolar space between the anterior surface of the sacrum and the mesocolon.

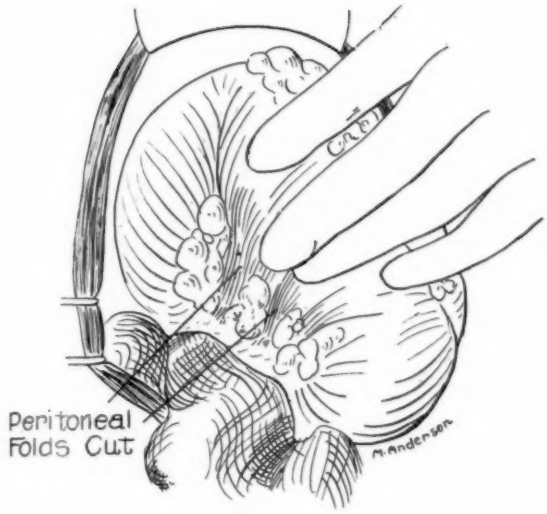
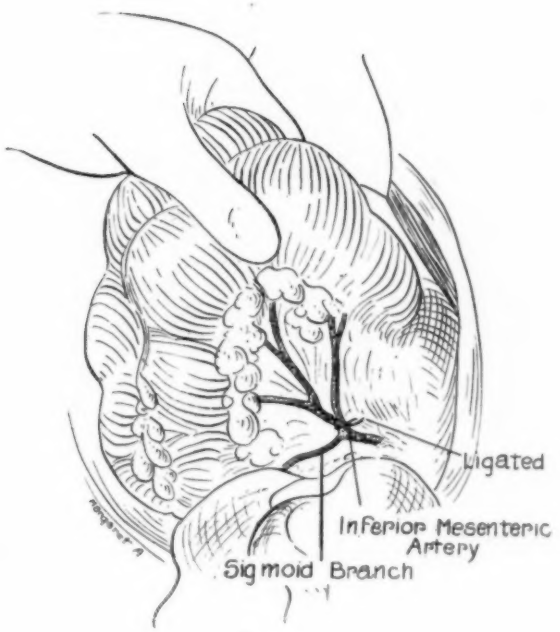


FIG. 1.



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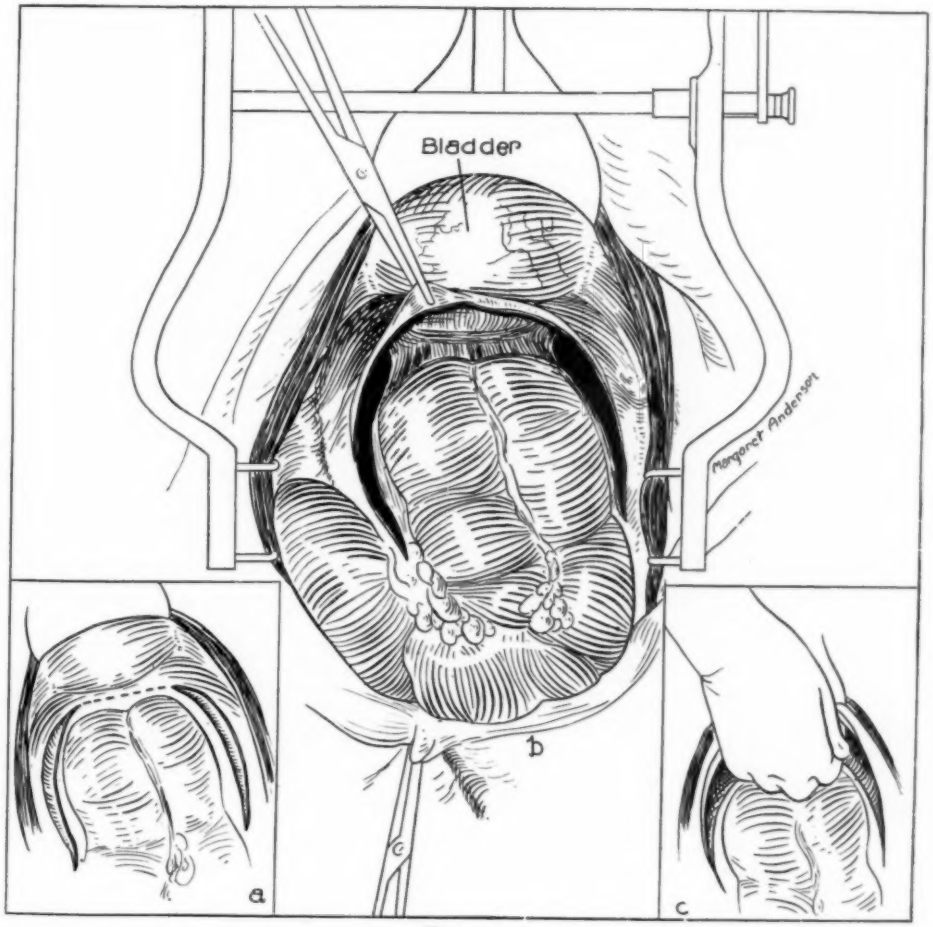
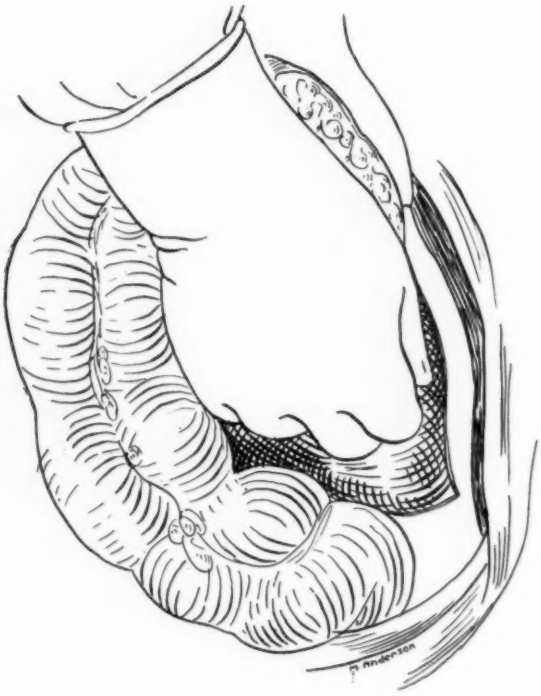


FIG. 3.

The fingers and eventually the hand are placed into this space and the pelvic colon and rectum can be easily stripped

tied with a heavy silk suture and a piece of rubber tissue is fastened over each end (Figs. 6B, C). This can be accomplished



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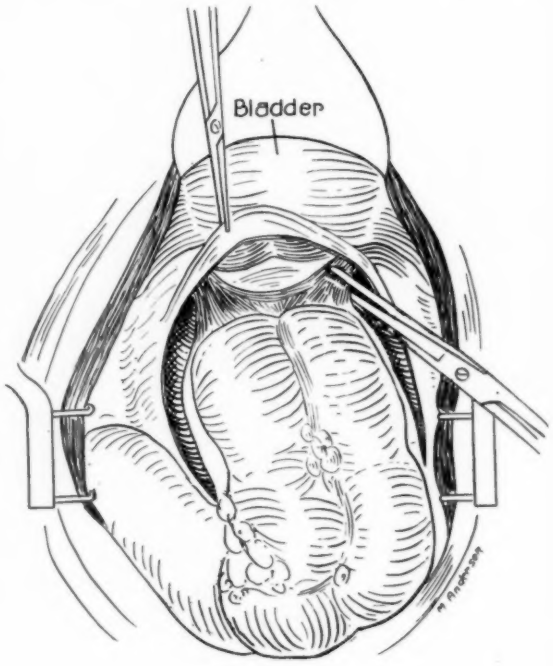

FIG. 5.

and pushed forward as far as the sacrococcygeal joint (Fig. 4).

The next step consists in the dissection of the anterior wall from its attachments. The peritoneum at the base of the bladder has been incised and this brings into view the seminal vesicles. These are pushed forward until the upper border of the prostate is felt. This procedure can be carried out with the fingers or under direct view with heavy blunt dissecting scissors. The cut edge of the peritoneum at the base of the bladder is now picked up and the four fingers are placed between it and the bladder. This portion of the peritoneum is pulled up gently until a good-sized flap is obtained which is to be utilized in the reconstruction of the pelvic floor (Fig. 3C). Traction on the bowel renders prominent the lateral attachments of the rectum which are divided (Fig. 5).

This completes the pelvic dissection and the colon is divided between clamps with the cautery (Fig. 6A). Both ends are

much more quickly than inversion of the ends and carries with it much less danger of contamination of the operative field. The Miles three-blade clamp may also be used for this procedure.

The end of the distal part of the pelvic colon is then pushed downward into the presacral space where it is easily accessible when the perineal part of the operation is being performed.

The next step consists of reconstruction of the pelvic floor from flaps of peritoneum from the base of the bladder and the lateral pelvic wall (Figs. 7A, B). Under no circumstances must any tension whatsoever be applied in this procedure. In cases in which these flaps cannot be brought together without undue tension, a graft of omentum is used to fill in the defect. Under no condition should the omentum be sewed around the flaps of peritoneum, for this predisposes to obstruction. The uterus and broad ligaments can be utilized in the female in the reconstruction of the new pelvic floor.

The proximal end of the colon is then brought out for the construction of the permanent colostomy (Fig. 7c). If the loop is long, it is preferable to bring it out through the original abdominal incision (Fig. 8). With proper protection of the wound, infection is not to be feared. The opening in this position is more satisfactory to patients, because regardless of whether they wear a colostomy bag or other dressings, the abdomen looks symmetrical, which is not the case with an inguinal colostomy. If the sigmoid loop is short, it is brought out through a left McBurney incision.

After closure of the abdomen, the patient is placed in the Kraske position and a purse-string suture is placed about the anus. A longitudinal incision is made in the midline to within 1½ inch of the anus and then encircling the anus to include a wide area (Fig. 9A).

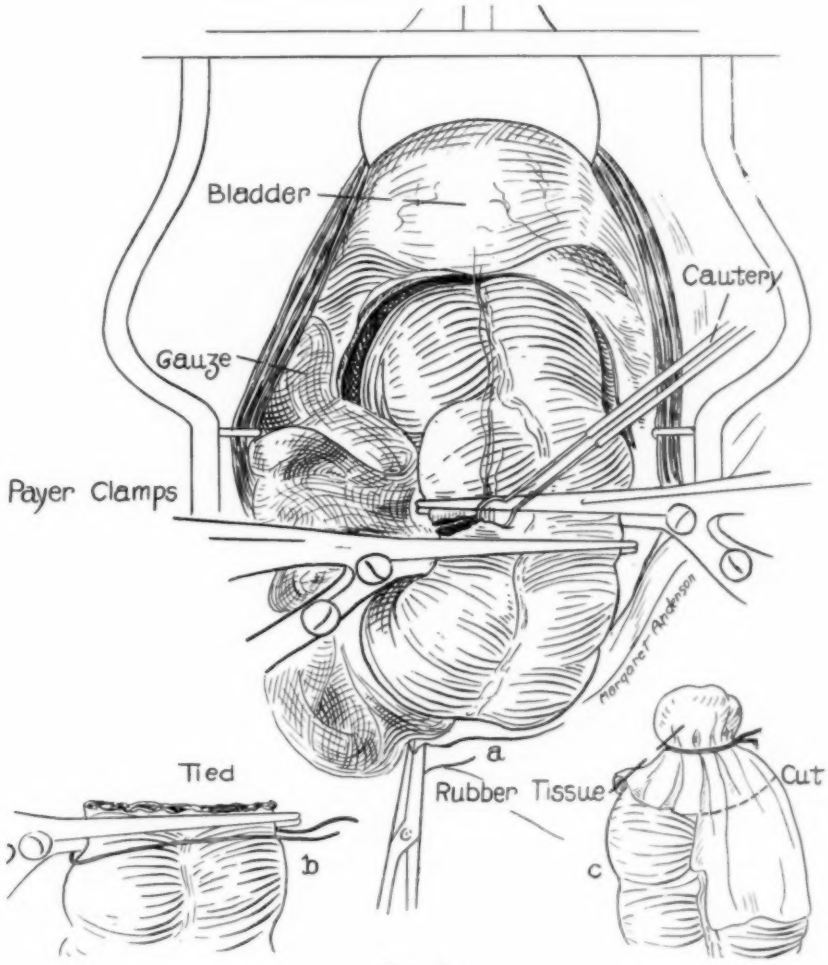

Fig. 6

The flaps on each side are then dissected back to the edge of the gluteal muscles. The coccyx is then disarticulated from the sacrum (Fig. 10) and the fascia immediately beneath it is incised. If the abdominal part of the operation has been properly executed, this permits entrance into the cavity containing the pelvic colon. The sacrococcygeal muscles are then cut on each side and the bowel is drawn out and stretched until the levator anus muscles are brought into view. These are divided as far away from the rectum as possible.

The anterior wall of the rectum is then separated from the prostate and the dissection is carried down anteriorly until

the operation is complete (Fig. 11). A catheter in the bladder is always useful as a guide so that the membranous portion of the urethra may not be injured.

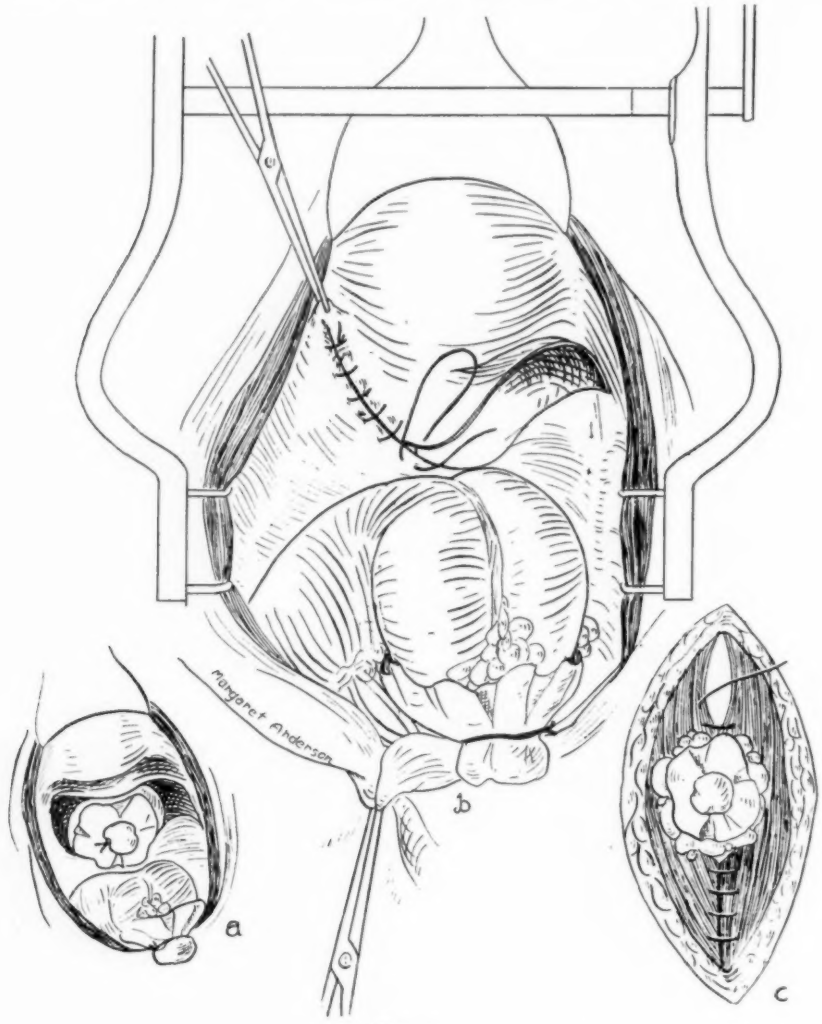

Fig. 7.

There now remains a large cavity which obviously must heal in by granulation and this requires from eight to twelve weeks. According to Miles' suggestion, a large thin rubber sheet is placed in this cavity into which gauze is packed. By using the rubber sheet, the gauze does not become adherent to the delicate pelvic floor which may tear away (Fig. 12). This method of packing supports the new pelvic floor and also prevents oozing from the large raw surface. Half of the gauze is removed on the third day after operation and the remainder of the packing, including the rubber sheet, on the fourth day.

The cavity then is irrigated with 1:8000 bichloride of mercury solution, boric acid or permanganate solution.

The colostomy is opened on the second or third day depending upon the amount of abdominal distention. Liquids are allowed from the second postoperative day, if the patient does not complain of nausea.

GENERAL CONSIDERATIONS

The success of the operation is dependent on several factors. First among these and of the utmost importance is the preoperative care. In a majority of these cases, chronic intestinal obstruction has existed for weeks or months and the contents of the colon are infected, but if

enough time is allowed and a careful regimen is instituted, the intestines can be decompressed.

The patient is kept in bed, but is allowed to get up to go to the toilet. Saline laxatives have proved most effective. One ounce of magnesium sulphate is placed in 8 ounces of water and the patient takes one ounce of the solution every half hour until it is consumed. This is continued for five, six or seven days. In addition, the patient receives a plain water enema daily. A high calorie non-residue diet is taken and in addition the patient receives 500 or 1000 c.c. of a 10 per cent solution of glucose daily. During his stay in the hospital the kidney function is checked and the blood groupings are determined for transfusion, which is a routine procedure either just before or after operation.

On the day before operation all purgatives and enemas are discontinued and three or four drachms of paregoric are administered during the day. If the hemoglobin has been below 70 per cent, a transfusion is given the patient immediately before operation. During the operation, the ratio of the pulse rate and blood pressure is watched carefully and whenever the indications call for it, 10 minims of adrenalin are given hypodermically. To avoid unnecessary handling, the bed is brought to the operating room.

After operation, the patients, particularly the obese, barrel-chested type, may be placed in an oxygen tent for the first twenty-four hours. No food or liquid is allowed by mouth the first day; after that, water is permitted if there is no nausea. Sodium chloride solution by the subcutaneous route or glucose solutions intravenously are administered daily until sufficient fluid can be taken by mouth. The colostomy may be opened any time, depending on the degree of abdominal distention or the discomfort of the patient. If it has to be done during the first forty-eight hours after operation, a catheter may be placed in the colostomy and the bowel can be tied around it to prevent too much soiling. If the wound has been covered with collodion, there is no appreciable danger of serious infection of the wound. About the tenth postoperative day, any excess bowel outside of the abdomen is cauterized

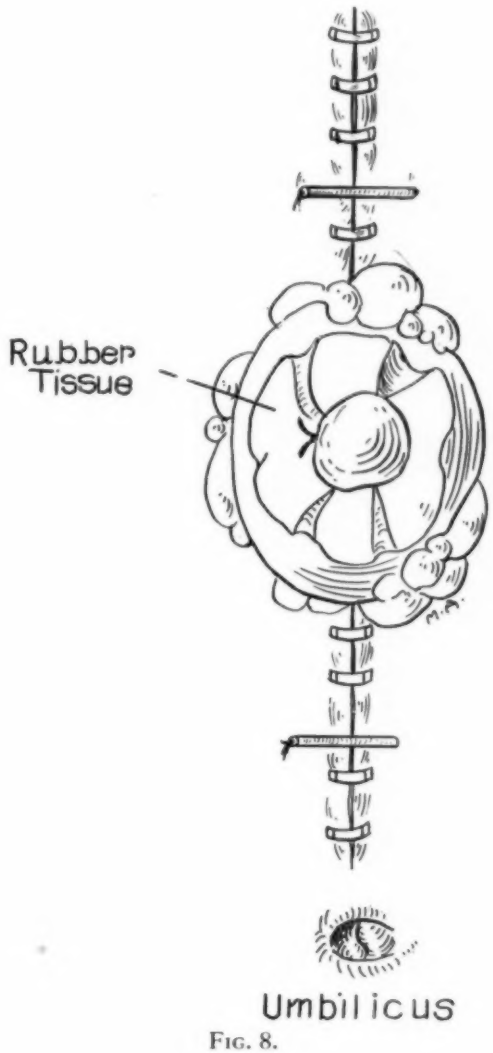

Fig. 8.

away down to about ¼ to ½ inch above the skin. This prevents any retraction when healing takes place.

The catheter is left in the bladder for about four days and if the patient is unable to void after that, he is catheterized two or three times a day so that there will be no overdistention. The patient is encouraged to get out of bed on the fourteenth day. Assumption of the upright position allows the new pelvic floor to sag little by little, which aids in the early filling of the posterior cavity. The average stay in the hospital after operation has been twenty-four days.

On account of the necessity for fre-

quent dressings which are required for some weeks, usually some member of the patient's family is taught the proper technique so that it is necessary that a physician see him only once a week. As soon as the colostomy is well healed, the patient is taught to irrigate the colon every two days and if a thorough evacuation is possible, in many cases there is no soiling until the next irrigation is made. Under this condition, only a small dressing is necessary underneath an abdominal binder. Where this can not be so satisfactorily regulated, a colostomy bag is worn.

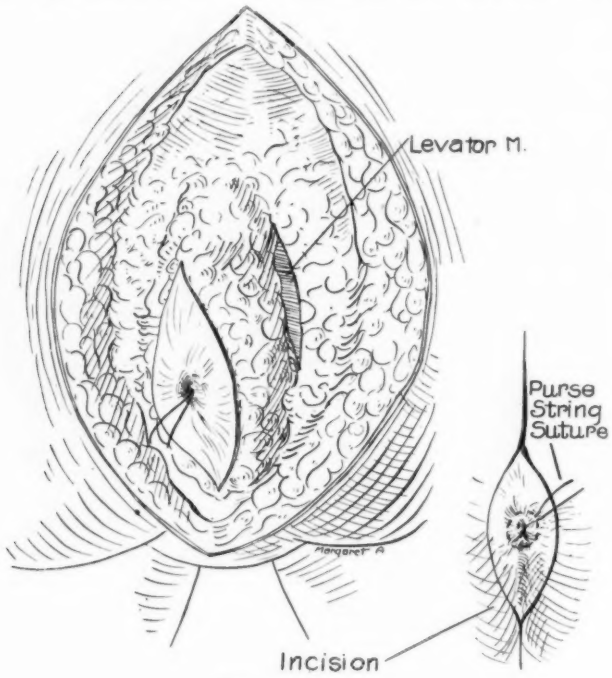

FIG. 9.

FIG. 10.

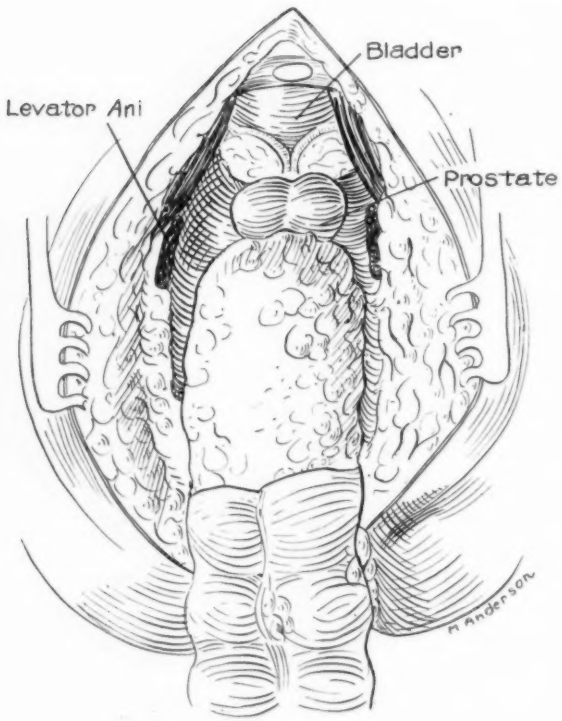

FIG. 11.

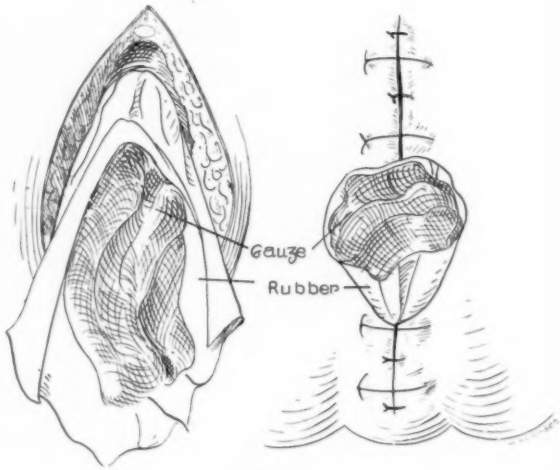

FIG. 12.

In a series of 127 cases in my experience there have been 14 deaths, a mortality of 11 per cent. In 52 per cent there has been immunity from recurrence for five years or more; in 63 per cent the patients have been free from cancer from three to five years; and in 70 per cent there has been no demonstrable recurrence under three years.

A TWO STAGE ABDOMINOPERINEAL RESECTION OF THE RECTUM AND RECTOSIGMOID FOR CARCINOMA*

FRANK H. LAHEY, M.D. AND RICHARD B. CATTELL, M.D.

BOSTON

THIS two-stage abdominoperineal resection of the rectum has been devised employing the advantages of the one-stage abdominoperineal resection described by Miles so that the operation may have a wider application, particularly in poor risk patients. By employing the well-recognized two-stage principles, the operative risk is diminished and operative shock and peritonitis have been definitely decreased. This two-stage modification permits the same radical resection of large bowel segments and mesentery as the one-stage procedure. The operation was originally described by one of us (F. H. L.)[1] in nineteen thirty but with later experience has been modified (R. B. C.) in order to overcome certain technical difficulties that have been encountered. The description of the operation which follows gives in detail the operative steps that have been employed routinely during the past three years in those cases of carcinoma of the rectum and rectosigmoid in which this operation seemed indicated. In the description of the operation, the reasons for the operative steps will not be discussed nor will the technical difficulties be presented but these will be discussed later in the paper.

OPERATIVE TECHNIQUE

The First Stage Operation. A left rectus incision is made splitting the fibers of the rectus muscle longitudinally at the junction of the middle and outer thirds of the muscle (Fig. 1). The deep epigastric vessels are ligated and divided in the lower angle of the incision and the peritoneum opened in the same direction as the original incision. The relative position of the incision in relation to the umbilicus is shown in Figure 1 and inset. A thorough abdominal exploration is next carried out, palpating both the superior and inferior surfaces of the right and left lobes of the liver. Careful examination of all of the large intestines beginning at the cecum is indicated in an attempt to discover polypi or possible multiple malignancies in other portions of the bowel. Glandular involvement is then sought for in the retroperitoneal area in the region of the aorta and lastly, the tumor-bearing portion of the rectum or rectosigmoid is felt in order to determine fixation, extension, size and possible local glandular involvement. At this point it seems best to have the pelvic peritoneum under direct vision for the discovery of local implants of the malignant process.

The operative exposure is easily obtained if an adequate abdominal incision has been made, particularly with the employment of spinal anesthesia. One moist abdominal pad will be sufficient to restrain the coils of small intestine from entering the operative field. The redundant sigmoidal loop is now drawn toward the median line (Fig. 2) by the assistant and the parietal peritoneum is divided approximately 1 cm. from the edge of the bowel from a point high on the sigmoid down to a point directly over the left iliac vessels. This permits elevation of the bowel and further retraction toward the median line leaving the mesentery intact. This step is illustrated in Figure 2. A point is now selected on the sigmoid for later division in such a way as to leave an adequate amount of

[1] Lahey, F. H. *Surg. Gynec. Obst.*, 51: 692, 1930.

* From the Lahey Clinic, Boston, Massachusetts.

bowel proximally to form the permanent colostomy, but being certain that there is sufficient bowel distal to this point to

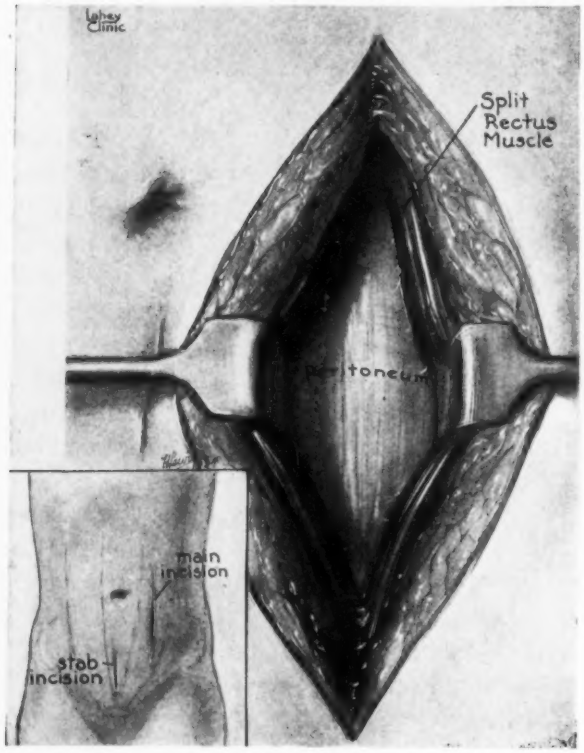

Fig. 1. First stage: Incision is made on left side splitting rectus muscle longitudinally. Relative position of primary and stab incisions is shown in inset.

permit its delivery well over to the median line after division (Fig. 3). The thin peritoneum over the mesentery of the sigmoid is then divided on its medial aspect down to the position of the superior hemorrhoidal vessels, and the same division is carried out on the lateral surface. On holding up the sigmoidal loop by means of a gauze sponge passed around it at the point that is to be divided, the vessels of the mesentery stand out clearly and can be secured with small pedicles of mesentery (Fig. 4). Before completing the division of the vessels of the mesentery near its root, it is extremely important to identify by palpation or under direct vision the superior hemorrhoidal vessels. They can be readily felt directly over the sacral promontory slightly to the left of the median line. *The division of the lower mesenteric vessels should not be carried out until this identification is certain.* The division of the mesentery of the sigmoid is always carried out at right angles to the

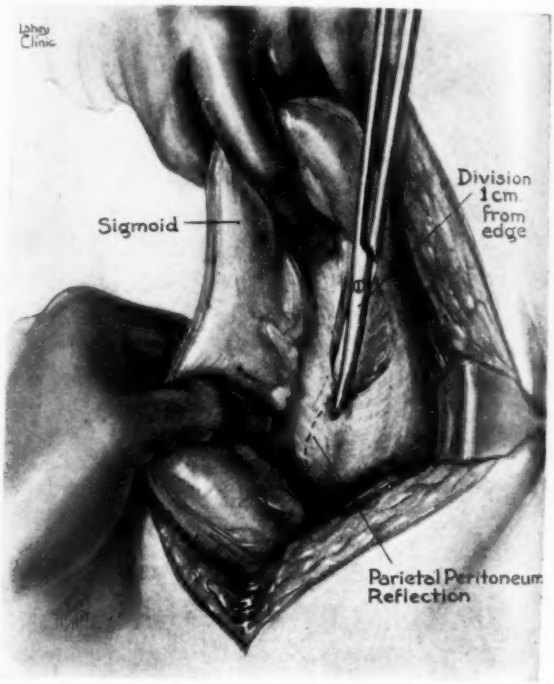

Fig. 2. First stage: Division of parietal peritoneum in an avascular portion allowing sigmoid to be freed up with its mesentery intact.

bowel with particular attention being paid to the course of the upper branches of the left colic artery which provide the circulation to the proximal segment (Fig. 4). Similarly, one can see the anastomotic branches from the superior hemorrhoidal vessels coming up in the mesentery of the distal segment. In certain patients it is possible to preserve a low branch of the left colic artery going to the distal segment in addition to the superior hemorrhoidal vessels.

A short stab incision, the position of which is shown in the inset of Figure 1, is now made suprapubically in the midline with the pyramidalis muscle serving as a guide. The peritoneum is opened at a point at least one inch above the bladder and the peritoneum is lifted up on each side by clamps (Fig. 5). Through this incision a right angled or long curved clamp is introduced and applied to the bowel distally at the point selected for division.

A second straight clamp is placed on the proximal segment through the original incision and the bowel divided by cautery

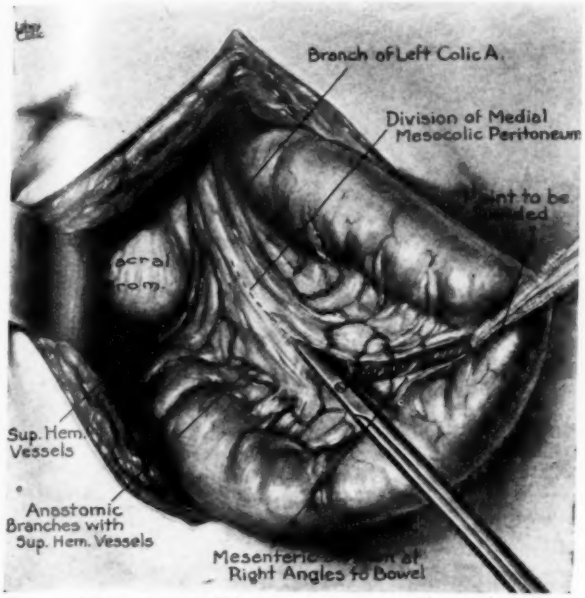
Branch of Left Colic A.
Division of Medial Mesocolic Peritoneum
Sup. Hem. Vessels
Anastomic Branches with Sup. Hem. Vessels
Right Angles to Bowel

Fig. 3. First stage: Division of mesocolic peritoneum down to superior hemorrhoidal vessels.

toneum of the stab wound and of the medial side of the main incision is now elevated and the curved clamp holding the

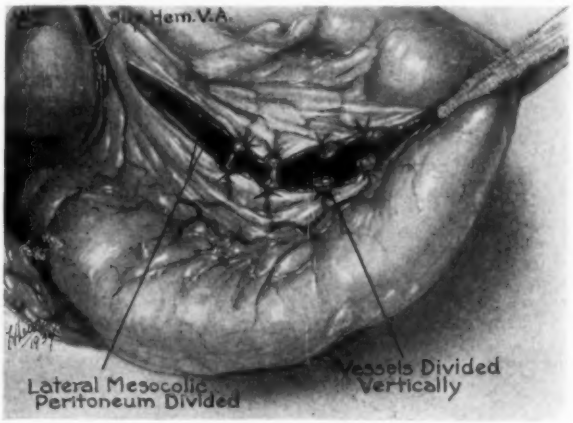

Fig. 4. First stage: Point for division of sigmoid has been selected and mesentery divided at right angles to this point. Note that superior hemorrhoidal vessels are carefully preserved.

distal segment is brought out suprapubically without coming in contact with the peritoneum. The peritoneum of the stab

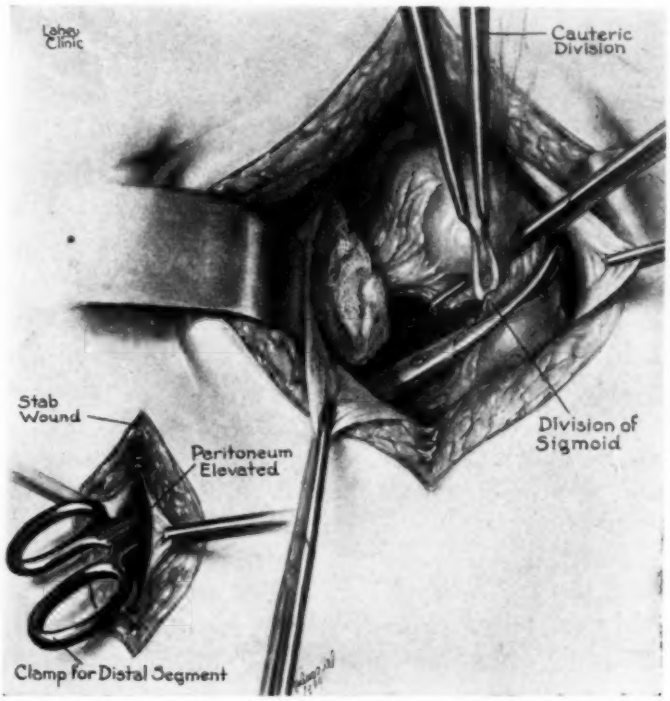

Fig. 5. First stage: Stab incision suprapubically has been made and a curve clamp passed through it to grasp sigmoid distal to point of division. Bowel is divided by cautery.

(Fig. 5). The redundancy of the bowel beyond each clamp is carefully burned down to avoid contamination. The peri-

incision is released and the skin is then closed loosely about the implanted distal segment (Fig. 6). This completes the

implantation and this wound is walled off with gauze pads.

The lumbar gutter or area lateral to the

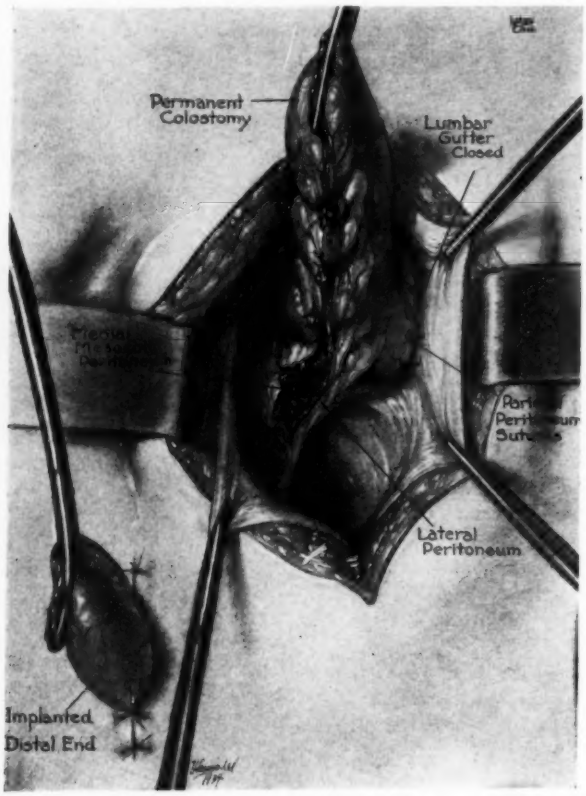

Fig. 6. First stage. Distal portion has been implanted suprapubically and skin closed loosely around it. Parietal peritoneum has been sutured laterally to proximal segment to close lumbar gutter.

proximal segment (permanent colostomy) is closed by interrupted or continuous sutures approximating the parietal peritoneum in a vertical direction to this bowel segment (Fig. 6). These sutures include only the fat tabs on the bowel or the small edge of parietal peritoneum which was left on the bowel in freeing it at the beginning of the dissection; the sutures do not include the bowel. At this point, the cut edge of the mesosigmoid has been stretched in a V with the apex in the region of the superior hemorrhoidal vessels and extending forward to the proximal and distal loops (Fig. 6).

The free edge of the omentum is drawn down and anchored to the medial mesocolic peritoneum at a point directly above the superior hemorrhoidal vessels. Interrupted sutures are then used to approximate the right side of the free edge of omentum along the cut mesentery of the distal loop up to and attached to the peritoneum under the stab wound; in a similar fashion, the left side of the free edge of omentum is attached to the mesentery of the proximal loop up to a point where it will be withdrawn from the abdominal wound (Fig. 7).

The primary incision is now closed in layers without drainage, bringing the permanent colostomy out somewhere near the middle of the incision at a point directly opposite to the attachment of the parietal peritoneum (Fig. 8). The peritoneum is anchored to the mesentery at a point just above the attached omentum and anchored to a fat tab on the amesenteric side in order to leave no aperture through which a loop of small intestine might enter. It will be noted that there are no sutures anchoring the bowel wall to the abdominal wounds in either the primary or stab incisions. These two implanted segments are held in place by the clamps, by their adherence to the wound, and by dry gauze which is wrapped around each protruding segment. It is quite important that at least an inch or an inch and a half of the bowel forming the permanent colostomy projects beyond the skin surface in order to have an adequate functioning permanent colostomy (Fig. 8). It is less important to have the distal segment come out so far, as it is implanted but temporarily and the clamp will serve to hold it satisfactorily.

This completes the first stage of the operation in the usual case. In some patients in whom the mesosigmoid is short and the sigmoidal loop not redundant, it may be impossible in the way just described to secure an adequate amount of bowel to form the permanent colostomy and still have a sufficiently long segment to reach a suprapubic position. In such instances, the left rectus incision is extended upward toward the costal margin sufficiently to expose the splenic flexure. The lateral peritoneal attachments to the

descending colon are then divided by continuing the division upward from the sigmoidal region and the avascular attachments of the splenic flexure completely divided, permitting the entire splenic loop to drop downward (Fig. 8A). This can be carried out readily without interference with the blood supply to this segment of the colon. This has permitted us to carry out this operation under the above circumstances.

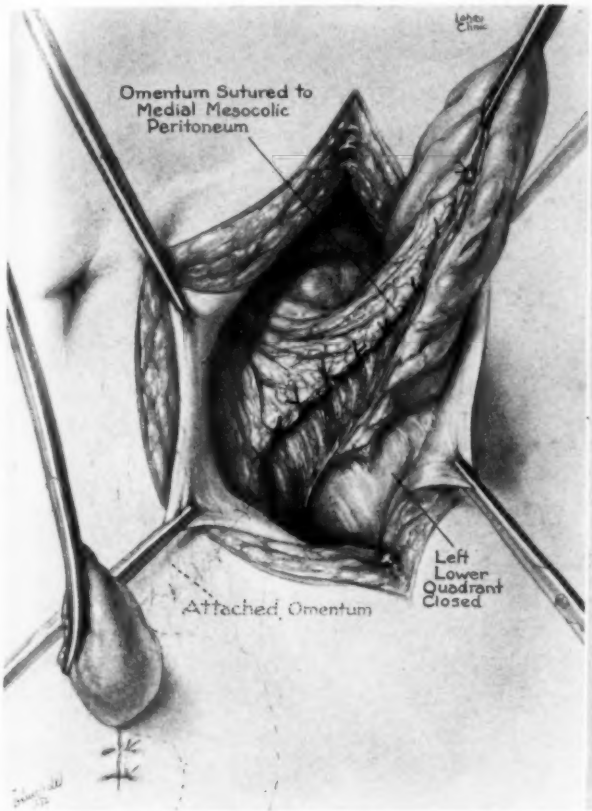

Fig. 7. First stage: Omentum has been sutured along upper border of cut edge of mesosigmoid to prevent adhesions along this area. This together with closure of lumbar gutter tends to close off left lower quadrant.

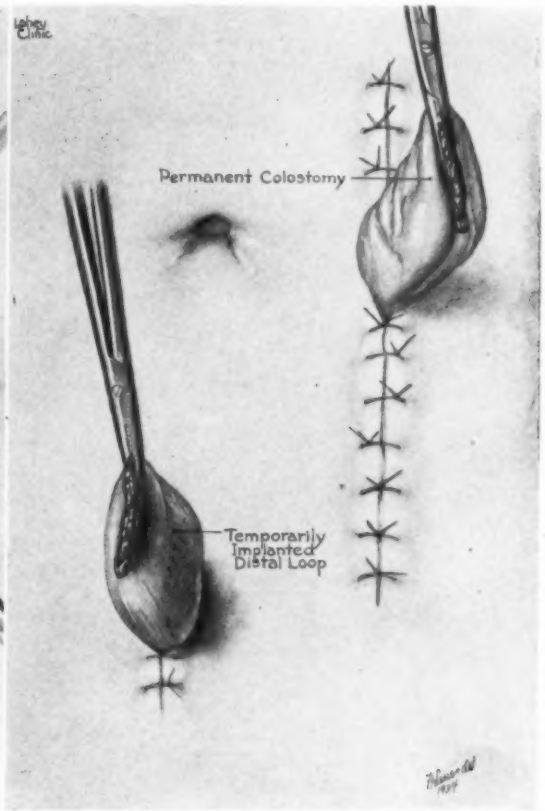

Fig. 8. First stage: Both incisions closed. Permanent colostomy has been brought out in mid portion of primary incision. Note amount of bowel which projects beyond skin.

The Interval between Stages: The clamp is removed from the permanent colostomy in forty-eight hours and a catheter inserted in this segment. If there has been a mild degree of obstruction this catheter can be inserted immediately at the conclusion of the first stage, but in non-obstructed cases the clamp is well borne for forty-eight hours. The lower clamp becomes detached or is removed five days postoperatively and from the sixth day on, the distal segment of bowel is irrigated two or three times daily until the second stage operation. It will be noted that the tumor-bearing segment now is exteriorized with one end opening suprapubically and the other end being the regular anal opening. The method of irrigation is schematically represented in Figure 9. A regular enema can is used with a large catheter inserted in the suprapubic colostomy and a large rectal tube or anoscope placed in the anus. In the presence of obstruction it may be necessary to wash it out both from above and below but after a few days it is rare not to be able to carry out the irrigation satisfactorily in a through-and-through manner. All of the feces can be evacuated and the daily production of blood, pus and mucus can be washed out. If one chooses to do so, an antiseptic solution can be used for the

irrigation immediately preceding the second stage operation. During this interval, satisfactory movements of the small amount of skin attached to it and the loop freed up except for its peritoneal attachment (Fig. 12). At this point,

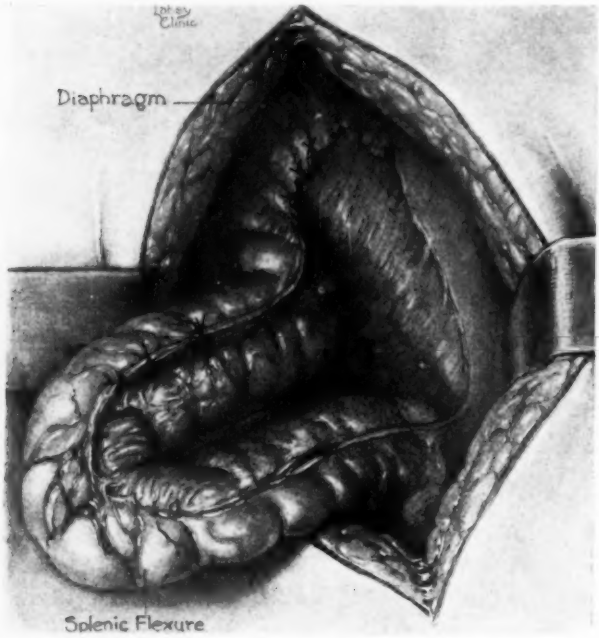

FIG. 8A. First stage: Freeing of splenic flexure. Avascular attachments have been divided by prolonging incision upwards. This is done only in those cases with a short sigmoidal loop where it is desirable to use this two stage abdominoperineal technique. It is rarely necessary.

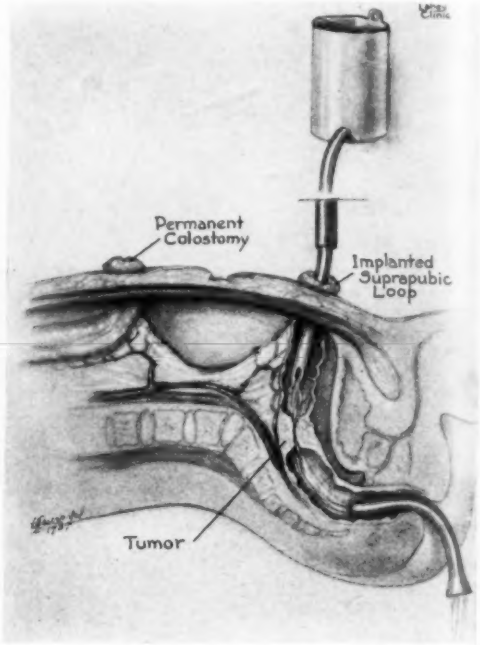

FIG. 9. Interval between stages. Schematic representation of method of irrigation of lower segment. This is carried out two or three times daily from sixth to fifteenth day.

bowel are obtained through the permanent colostomy. The average length of time between stages is fifteen days, but the second stage can be delayed if necessary since the lower loop is viable.

The Second Stage Operation: A small piece of gauze is placed over the permanent colostomy and the area walled off with broad adhesive strips. The implanted distal loop is now closed by interrupted and continuous sutures without separation of the skin edges (Fig. 10). The abdomen is prepared in the usual way and the patient placed in a moderate Trendelenburg position. The abdomen is then opened just below the umbilicus in the median line at a point well above the implanted loop. By this means, the abdomen can be opened quickly at a point where there are no adhesions (Fig. 11). The skin incision is continued downward encircling the implanted loop (Fig. 12, inset), leaving a

the operator dislodges the adhesions directly beneath the peritoneum, making certain that any attachment of the loop to the bladder is bluntly separated. The peritoneal attachments can be quickly divided as shown in Figure 12 without danger of opening the bowel or of injury to the bladder. A piece of rubber tissue is tied around the implanted loop to protect against further contamination (Fig. 13). This leaves the previously sutured omentum attached to the mesentery of the loop which can be disengaged by a combination of sharp and blunt dissection, down to the point where the superior hemorrhoidal vessels can be identified (Fig. 13).

After the omentum has been freed from the distal segment, adequate exposure of the pelvis can be quickly obtained by retraction of the small intestines over moist abdominal pads. If the exposure is not adequate, the incision is extended upward to either side of the umbilicus.

The superior hemorrhoidal vessels are now ligated and divided at the pelvic brim and the pelvic peritoneum is incised on each side of the bowel as far lateral as is practicable (Fig. 14). The right ureter can always be identified over its pelvic course at this point and at times the left ureter will be seen. The peritoneal incision is continued forward to the bladder in male patients and the loose attachments of the extraperitoneal portion of the bowel to the bladder and prostate are divided (Fig. 15, inset). The operator's hand can now be inserted into the hollow of the sacrum and all of the posterior attachments of the rectum separated by blunt dissection well down to the tip of the coccyx (Fig. 15). This part of the dissection must extend as low as possible in order to facilitate the perineal delivery of the segment. With the position of the ureters recognized, the lateral attachments of the rectum are divided by a combination of blunt and sharp dissection with it rarely being necessary to secure any additional blood vessels. If the rectal segment has been sufficiently freed (Fig. 15) one can readily palpate the prostate or vagina anteriorly and the segment will be freely movable. The entire segment of bowel is placed in the pelvis in the presacral space placing the previously implanted and free end down to the coccyx by bending the segment backward upon itself (Fig. 16, inset A). A gauze sponge is pushed down over the segment to hold it firmly in place (Fig. 16, inset B). In certain cases because of the length of the bowel segment or because of the size of the tumor, it will be necessary to remove a portion of it in order to permit reduction into the pelvis. If this becomes necessary, a heavy ligature is placed about the bowel and the segment divided between the ligature and a right angled clamp, cauterizing the

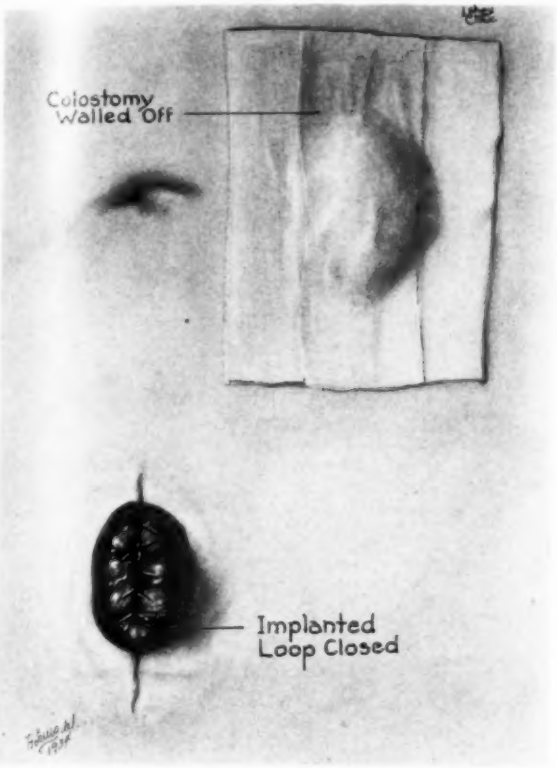

Fig. 10. Second stage: Permanent colostomy has been walled off and implanted suprapubic loop closed superficially.

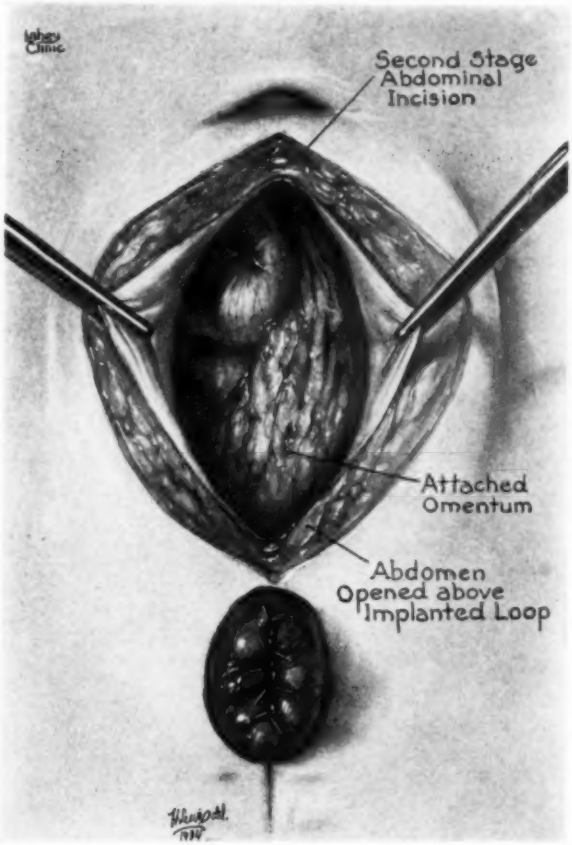

Fig. 11. Second stage: Abdomen has been opened between umbilicus and implanted suprapubic loop in midline. Coils of small intestine are encountered as well as omentum which has been attached to mesentery of implanted loop at first stage.

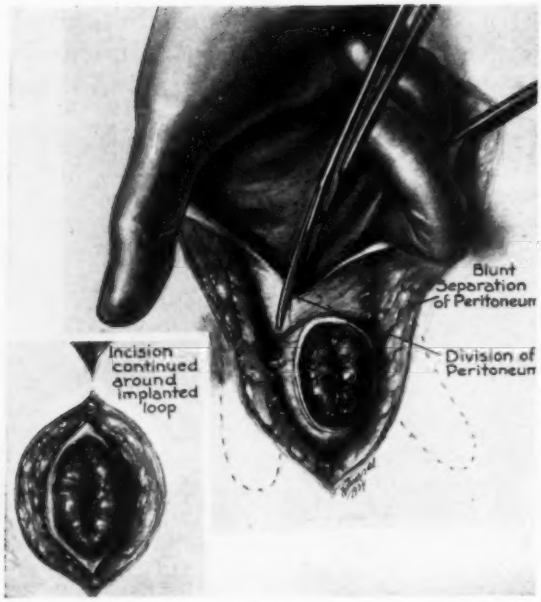

FIG. 12. Second stage: Inset shows continuation of midline incision around closed implanted loop. After freeing adhesions to under side of peritoneum implanted segment is freed.

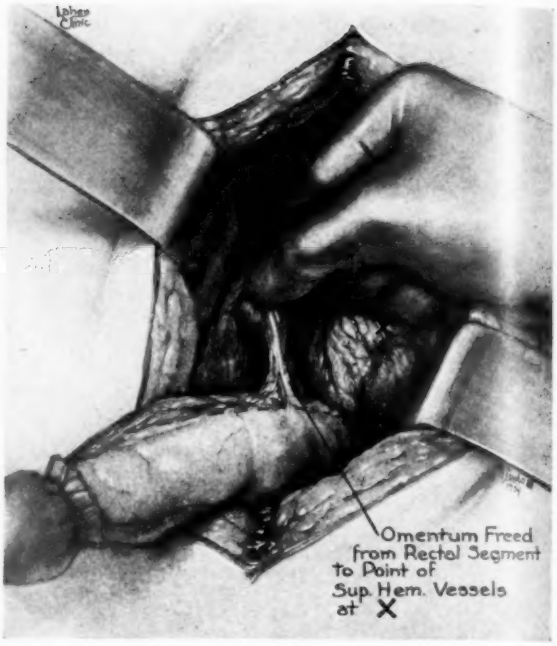

FIG. 13. Second stage. Attached omentum is freed from distal segment by blunt dissection down to superior hemorrhoidal vessels. Implanted end is protected by a sheet of rubber tissue.

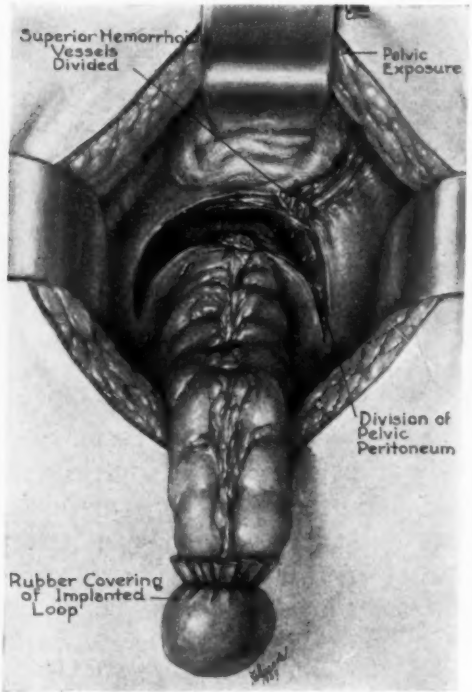

FIG. 14. Second stage: Superior hemorrhoidal vessels have been divided and peritoneal incision made laterally at pelvic brim.

FIG. 15. Second stage: Inset shows peritoneal incision continued forward around and over bladder dividing loose anterior attachments of rectum. Main drawing illustrates freeing up of rectal segment from sacral hollow and division of lateral attachments.

mucosa of the distal end above the ligature.

Before the closure of the pelvic peritoneum, one should decide whether resection of the presacral nerve is indicated. This is carried out in patients who are on the borderline of operability with considerable local glandular involvement or in those cases in which the tumor is adherent to the bladder or in the region of one of the ureters. The branching filaments that go to make up the presacral nerve can be readily picked up over the sacral promon-

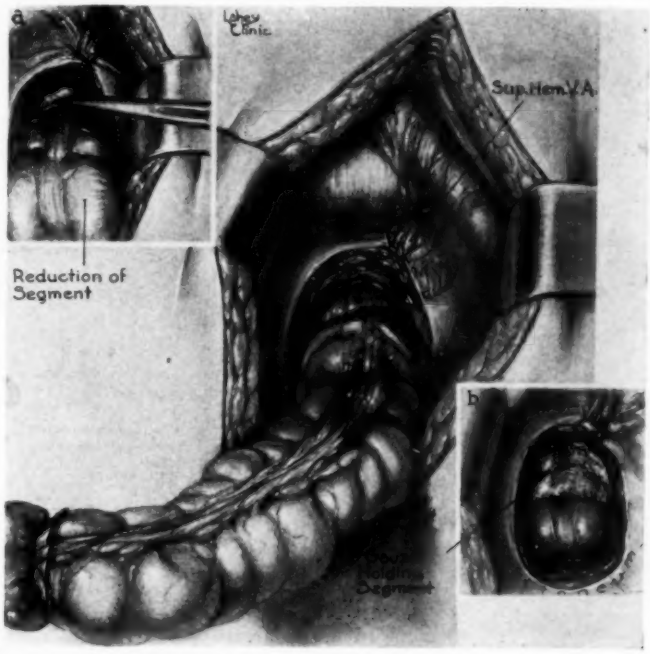

Fig. 16. Second stage: Inset A shows reduction of bowel segment into presacral space. Inset B shows bowel reduced below level of pelvic peritoneum and held in place by a gauge sponge.

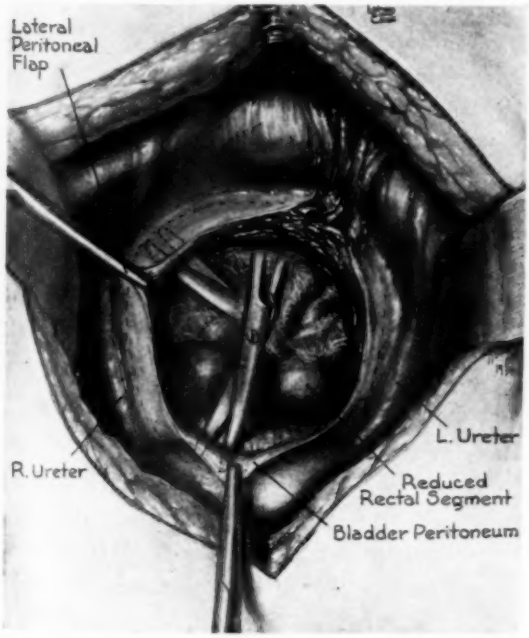

Fig. 17. Second stage: Freeing of pelvic peritoneum from loose lateral attachments and from bladder. Outline of ureters can be seen on each side.

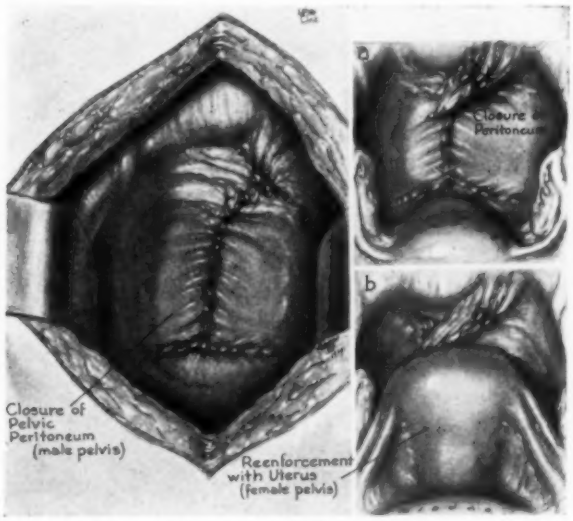

Fig. 18. Second stage: Pelvic peritoneum has been adequately closed in two directions without tension (represented in a male patient). Inset A. Closure of pelvic peritoneum, female patient, with suture line reinforced with fundus of uterus in inset B.

tory in the small triangular space formed by the common iliac vessels.

The peritoneum on the lateral pelvic wall is next freed up sufficiently to approximate the two sides (Fig. 17). Frequently there will be some difficulty in getting sufficient peritoneum to approximate it without tension. In the male patients, a part or all of the bladder peritoneal reflection can be freed to facilitate this closure (Fig. 17). We consider this step as one of the most important in the second stage of the operation. It will usually be necessary to close this pelvic peritoneum in two directions to avoid tension (Fig. 18). In the female patients the uterus can be utilized to reinforce this suture line as shown in Figure 18, insets A and B. In the male patients if one is in doubt as to a satisfactory closure, the omentum which has been previously freed from the distal segment can be brought down and stitched over the peritoneal suture line.

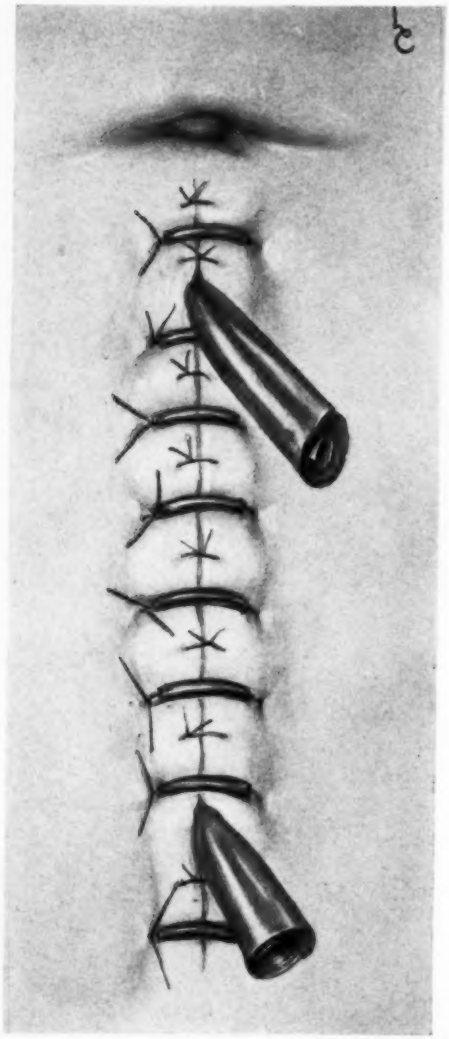

FIG. 19. Second stage: Closure of abdominal wound, suprapubic drainage that extends only to anterior peritoneum.

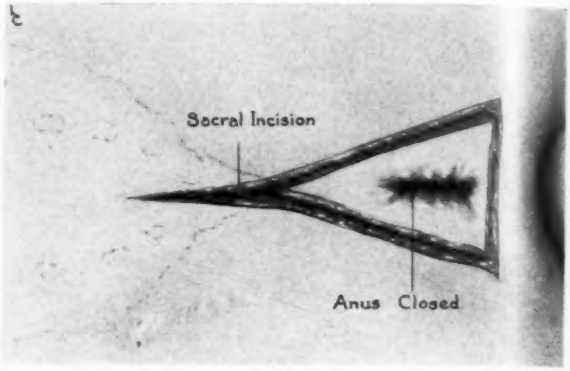

FIG. 20. Second stage (perineal resection). Anus has been closed and enclosing triangular incision extending upward over sacrococcygeal joint has been made.

The incision is closed in layers without drainage into the peritoneal cavity and the wound reinforced by retention sutures. A small suprapubic drain down to the anterior peritoneum is used and at times a similar drain is brought out in the upper angle of the incision (Fig. 19).

The perineal part of the operation is carried out with the patient on the left side in a modified Sims position. The anus is closed, and a triangular incision with the base toward the genitals is made enclosing the anus (Fig. 20). The entire sacral area is prepared in the usual manner and the vagina likewise prepared. The incision is continued upward to a point well above the sacrococcygeal junction (Fig. 20). The subcutaneous tissues are divided down to the levator ani muscles. The coccyx is removed in male patients and in female patients where the lower pelvic outlet is small, and the middle sacral artery is then secured. A transverse incision is made across the tough pelvic fascia immediately in front of the sacrococcygeal joint and the free sacral space is entered. The entire bowel segment is delivered and the sponge which was left abdominally re-

moved (Fig. 21). The finger can be introduced under the levator ani muscles on each side and these severed as far laterally

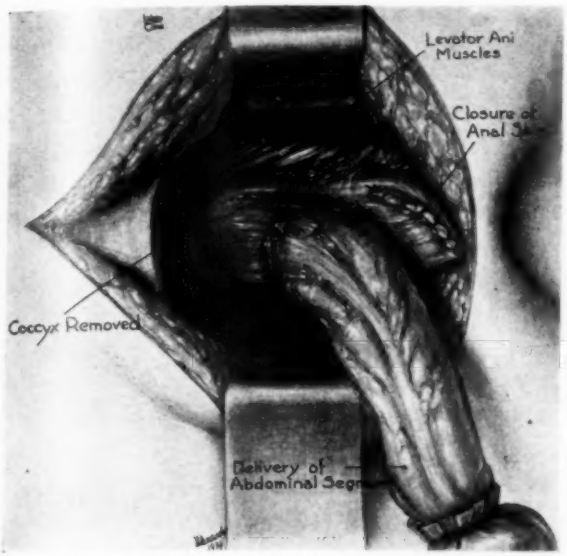

Fig. 21. Second stage (perineal resection). Coccyx has been removed, presacral fascia divided and pelvic segment delivered.

as possible; in doing this the middle and inferior hemorrhoidal vessels must be secured. This leaves the lower rectal and anal segment attached anteriorly where the cleavage plane will be somewhat difficult to identify. The anus is then drawn upward and the perineal muscles divided by sharp dissection (Fig. 22). In female patients it will greatly facilitate the dissection by introducing the finger into the vagina to guide one in carrying out this step. After removal of the entire segment of bowel, careful inspection of the large pelvic cavity can be facilitated by directing the light into the pelvis. It should be possible to obtain a dry field before closure. In those cases in whom the perineal dissection has been carried far laterally, it will be possible to close only the subcutaneous tissues and skin of the perineal wound. A cigarette drain is laid loosely in the pelvic space, preferably not having it come in contact with the pelvic peritoneal suture line. The drain should be brought out through the middle of the incision, well away from the denuded end of the sacrum (Fig. 22, inset).

At the conclusion of each resection, a blood transfusion of 500 c.c. is routinely given, usually by the citrate method. An inlying catheter is placed in the bladder for

Fig. 22. Second stage (perineal resection). Levator ani muscles have been divided laterally. Anus and lower rectal segments are being freed. Inset shows closure of perineal wound with a cigarette drain coming out of mid portion of incision.

constant drainage in order to make sure that there is no bladder distention which might produce an unfavorable amount of tension on the pelvic peritoneal suture line.

The drains in the abdominal wound are removed on the fourth day and at the same time the cigarette drain is removed from the perineal wound. The latter is replaced by rubber dam tissue. Beginning on the sixth or seventh day the perineal wound is irrigated with normal saline or a dilute iodine solution (z$\bar{ss}$ in oi of water) three times daily. The perineal wound continues to drain after leaving the hospital and should be kept open to prevent accumulation and abscess formation. All patients are carefully taught concerning the care of their colostomy before leaving the hospital. Following the regimen previously described by one of us (R. B. C.)[2] the colostomy should be under control

[2] Cattell, R. B. *New England J. Med.*, 208: 740, 1933.

within one month after leaving the hospital.

There are a number of advantages of a two stage abdominoperineal resection of the rectum. Some of these are utilized by other two-stage modifications (Lockhart-Mummery, Kraske, W. J. Mayo, D. F. Jones, Coffey, Rankin and others). In regard to the two stage operation we have described these may be enumerated as general and local benefits:

General. 1. The patient's general condition can be considerably improved between stages.

2. A normal functioning colostomy is established before the radical part of the operation is carried out.

3. The operation can be done in cases with mild obstruction.

4. A peritoneal immunity may well result from handling and dividing the bowel at the first stage as evidenced by the low incidence of peritonitis following resection.

5. There is less operative shock.

6. The operation is no less limited in extent.

7. The operation can be carried out more often in complicated cases, in elderly and poor risk cases.

Local. 1. Cleansing of the tumor-bearing segment by irrigations can be carried out without danger.

2. The local conditions around the tumor, i.e. edema and infection, have an opportunity to improve.

3. Viability of the segment to be resected is maintained between stages.

There are certain technical disadvantages of this two stage abdomino-perineal resection that should be mentioned. It does not divide the operation in two equal parts since at the second stage, the resection consists of an abdominal and perineal portion making it necessary to enter the abdomen both during the first and second stages. It is true too that the first stage is a larger operation than an ordinary loop colostomy. Finally, adhesions as a result of the first stage may complicate the second stage resection.

We feel that certain of the technical disadvantages have been overcome by the modifications described in this paper. The advantages of making the left-sided incision at the first stage are considerable. Since this operation is on the sigmoid and in the left side of the abdomen, it is easier to deal with the sigmoid by this approach. It enables a more satisfactory closure of the lateral gutter under direct vision. Most important of it all, it permits entering the abdomen at the second stage operation through the abdominal wall at a point not complicated by a previous incision. Earlier in our experience we found that adhesions, particularly of small intestinal loops, frequently complicated the second stage. This has been avoided by the use of the omentum along the cut edge of the mesentery which together with the closure of the lumbar gutter to all practical purposes closes off the left lower quadrant of the abdomen.

In carrying out the perineal part of both this operation and the one-stage operation we found that the patients went into profound shock when placed on their abdomen after the abdominal portion had been completed. This perineal part can be as readily carried out with patients on the left side as on their abdomen and only small drops in the blood pressure will be found by this change of position. We do not believe it is feasible to attempt the perineal resection in a modified lithotomy position.

SELECTION OF CASES

We should like to state emphatically that no one type of operation should be applied to all patients with cancer of the rectum and rectosigmoid. We still employ the one stage abdominoperineal resection in good risk patients, particularly those under fifty years of age. Approximately one-half or 50 per cent of the resections of the rectum and rectosigmoid in this Clinic are done by the two stage modification described in this paper. There are an

appreciable number of elderly obese, poor risk cases who will not successfully stand an abdominoperineal resection in either one or two stages. These, particularly with the lesion in a low rectal position, are best treated by preliminary colostomy followed by perineal or sacral resection. There is another small group of patients with lesions high in the rectosigmoid that can be best resected anteriorly, establishing a colostomy at the same time as the resection, and leaving a small rectal stump in place. We feel very strongly that any patient with cancer of the rectum or rectosigmoid should have resection if it is technically feasible to remove the growth.

In this Clinic up to 1928 approximately 55 per cent of the cases seen were resected, but this figure has steadily mounted until at present 70 per cent of all cases are submitted to one of the four types of resections just mentioned.

We prefer spinal anesthesia for carrying out this operation in all patients that are in good condition. It gives a sufficiently long anesthesia to carry out either stage of the operation. In poor risk cases, however, we employ intratracheal ethylene or cyclopropane anesthesia with the carbon dioxide absorption technique. This combined with field block of the anterior abdominal wall gives very satisfactory operative conditions.

This two stage abdominoperineal resection has been utilized in this Clinic in 60 patients with carcinoma of the rectum and rectosigmoid. With an increasing experience with its use, the earlier technical difficulties have been avoided, and we feel that there will be a lower incidence of complications and operative mortality if it is properly applied. There have been six operative deaths, a mortality of 10 per cent. Sufficient time has not elapsed since this operation has been employed to report the incidence of recurrence after this two stage abdomino-perineal resection, but we feel the end results will compare favorably with those after abdomino-perineal resection in one stage.

GRADED PERINEO-ABDOMINAL RESECTION

OF THE RECTUM AND RECTOSIGMOID

FRED W. RANKIN, M.D.

LEXINGTON, KY.

GRADED operations for cancer of the rectum are usually done for one or more of the following reasons: first, inadequate decompression evidenced on exploration by edema and thickening of the musculature of the bowel wall and infiltration in the mesentery; two, inability of the patient to stand a formidable radical resection in one stage; and three, borderline operability. This latter group cannot be definitely defined but includes those cases in which, under drainage and irrigations, the fixation of the bowel recedes, the general resistance is increased, and removal may be undertaken subsequently, provided there are no metastases demonstrated at the original exploration.

Graded maneuvers are usually carried out in two phases: first, exploration and decompression by cecostomy, or manufacture of a permanent single-barreled colostomy; and second, removal of the segment of bowel containing the growth, and the gland-bearing tissues in juxtaposition to it.

EXPLORATION

Position. The ease of operation and comfort of exploration is greatly facilitated by having the patient placed in a fairly deep Trendelenburg position with the surgeon standing on the left side of the table.

Incision. In my experience the most satisfactory incision for exploration from every standpoint is a low mid-line one, since split muscle incisions on the left side, or incisions through the left rectus muscle, as advocated by some, have several distinct disadvantages. That is, they are subject much more frequently to hernia formation and prolapse of a large portion of the left colon, which will not be noted unless one examines carefully a number of these patients months or years after the operation. The average sized hand and forearm which must be thrust into an incision to approach and palpate the liver and upper abdomen necessarily require a fair-sized opening. This is especially true if one makes an incision through the left rectus muscle where even snug closure, when followed by continuous pressure of a ring colostomy pouch, results in ventral herniae in a high percentage of cases. I have yet to see a left rectus incision which has been used for exploration and the simultaneous establishment of a loop colostomy which did not at the end of six to twelve months show a hernia. A much smaller percentage of herniae will occur around a split muscle incision, but I venture to assert, without having studied the statistics, that 25 to 35 per cent of these will likewise show herniation at the end of a year.

One advantage of a low mid-line incision is that it may be made simply and to the adequate size for exploration and then closed snugly in the full expectation of healing per primam. The colostomy, if one is made at the initial maneuver, is accomplished through a small stab wound in the left groin which obviates prolapse and herniation. An additional advantage is that one may change one's mind about the type of operation indicated, after exploration is completed. Sigmoidal and rectosigmoidal growths sometime prolapse down into the ampullary portion of the rectum and appear as rectal growths, and on exploration the intussusception may be

disengaged and the tumor accurately located much higher up in the bowel. I have seen an intussusception of a growth

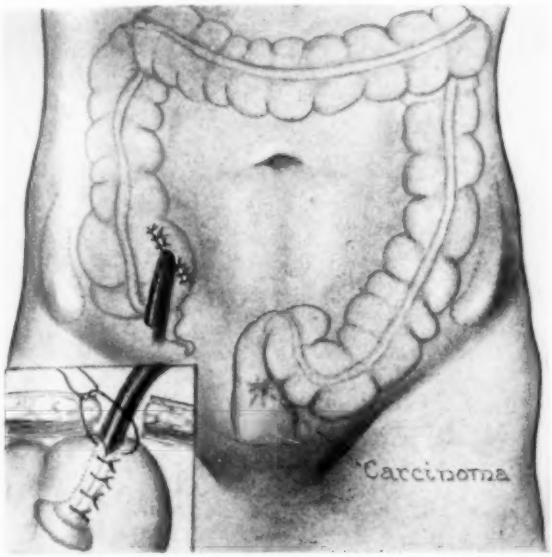

Fig. 1. Graded perineo-abdominal resection of the rectum and rectosigmoid, first stage. When preliminary decompression is inadequate, a cecostomy after exploration through a low mid-line incision is made by introducing a Pezzer catheter after the Hendon method. The catheter is withdrawn through a stab wound in the right groin.

of the descending colon appear in the rectum and the diagnosis of rectosigmoidal carcinoma made. If one has a low midline incision and such a condition is encountered, the incision may be enlarged and any type of operation elected carried out through it. Sistrunk many years ago began the use of this type of incision for exploration and for the first stage of the graded maneuver, and I am convinced that it is more desirable than any other type of incision for the reasons mentioned.

Having opened the abdomen, exploration should be carried out in an orderly sequence from the upper abdomen to the pelvis. The hand is thrust upward to the liver, the surfaces of which are carefully and accurately palpated for metastatic deposits. Then, the exploration procedes from above downward, noting the presence or absence of hard or enlarged glands around the pancreas, along the aorta, and in the bifurcation of the iliac vessels. Whether or not enlarged glands are malignant can only be determined by the pathologist after removal for microscopic section, and consequently their presence does not

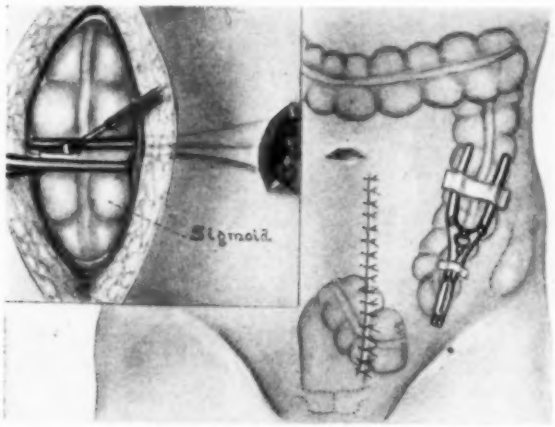

Fig. 2. Graded perineo-abdominal resection of the rectum and rectosigmoid, first stage. Manufacture of a colostomy high in the sigmoid, which is divided between Payr clamps. The proximal clamp is thrust through a stab wound in the left groin. The distal clamp is applied in the opposite direction and the bowel severed with a cautery. The end of the distal segment of bowel is inverted and dropped back. This colostomy may be made at the first stage, or if decompression is inadequate and cecostomy is used, the colostomy may be made at the second part of the operation.

rule out radical removal of the rectum in one or two stages.

The pelvis and the growth should be explored last. Deposits on the floor of the pelvis should be noted and if necessary removed for pathological examination. The growth itself is palpated very tenderly and lightly to determine its fixation. The immobility of the local growth is one of the most important factors in determining its operability, and I believe that any growth which is not rigidly immobile should be extirpated in the absence of liver nodules, provided the individual's resistance will withstand a radical operation, with a reasonable mortality. It should be emphasized that the examination to determine the fixation should not be vigorous because of the danger of spreading organisms into the peritoneal cavity. It is a well-established fact that the permeability of the bowel is increased by ulceration associated with obstruction, and that many virulent infective organisms may thus be released

by manipulation, into the peritoneal cavity.

Having decided at exploration that the growth is resectable, the next consideration is whether the operative procedure is to be carried out in one or two stages. If it seems desirable to do a graded operation, one may either do a cecostomy or a single-barreled colostomy. The choice of these two procedures depends, I think, almost entirely upon the adequacy of the preoperative decompressive measures. If the bowel is found to be edematous, thickened, with an infiltrated mesentery, and with evidences of unrelieved obstruction, a cecostomy with a large No. 28 Pezzer catheter is the procedure of choice. This is done by either utilizing the original incision and making a stab wound to draw out the catheter, or by closing the original incision and making a split muscle incision through which the cecostomy is performed.

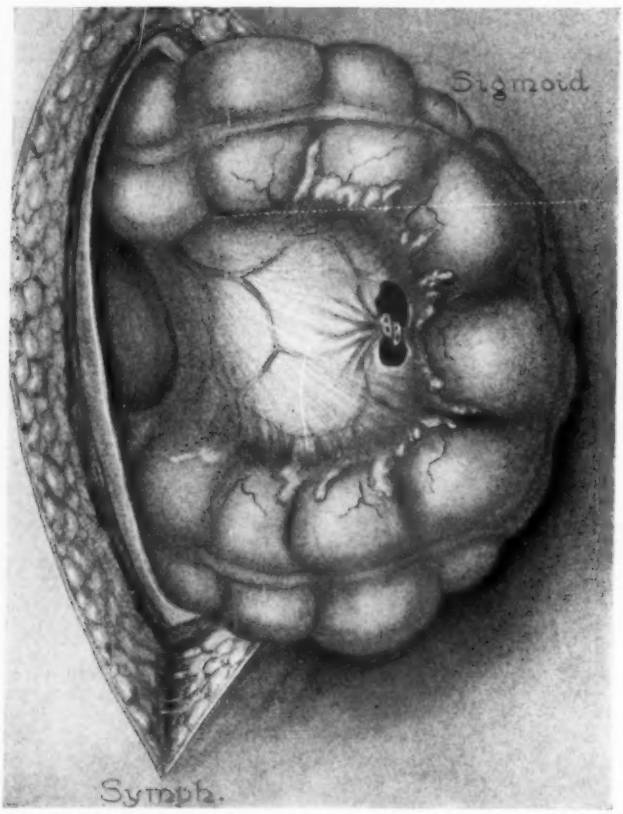

Fig. 3. Graded perineo-abdominal resection of the rectum and rectosigmoid, first stage. Adequate vascularization with the two ends of bowel utilized in the manufacture of the colostomy is assured by ligating the single vessels in the mesentery close to the bowel wall, under actual visual inspection.

The use of a Pezzer catheter for cecostomy was first called to my attention by Hendon and I have found it a most valuable procedure for decompression. The catheter should be large enough to relieve the bowel of its gas and fluid content and to facilitate, as convalescence procedes, irrigations through and through. I heartily deprecate the idea of bringing out the entire cecum through a split muscle incision to side-track the fecal current. Such a procedure accomplishes a complete side-tracking it is true, but at the same time it increased the chances of infection at the second operation, and requires a major procedure for a closure in a third stage. In decompression it has no advantages over a large catheter.

Adequate decompression is largely a matter of relief of gas and fluid content. Inspissated fecal matter is of no importance in the subsequent stage. When the patient

has been decompressed and rehabilitated and is in condition to procede with the second operation, an additional advantage arises in having the cecostomy, which relieves the newly manufactured colostomy from pressure until the tissues have sealed off. There is a group of cases, not inconsiderable in number, where acute intestinal obstruction is the syndrome for which the surgeon is consulted, secondary though it be to an obstructing lesion in the rectosigmoid or lower sigmoid. For this group of cases, the establishment of a blind cecostomy is the ideal procedure. After decompression has taken place, radiography or proctoscopy reveals the location of the growth and its extirpation may be undertaken later by a radical procedure just as one would in a deliberate two-stage maneuver.

Six times during the past year when confronted by low sigmoidal and rectosigmoidal growths, I have done a cecostomy and exploration, and subsequently done a radical second stage perineo-abdominal operation without mortality. I believe that this particular maneuver of cecostomy and perineo-abdominal resection in two stages has a wide field of application and perhaps may be the graded maneuver of choice. The disadvantage of a persistent fistula following cecostomy or ileostomy does not occur in the use of the Hendon method provided the catheter is introduced by the Witzel technique. Thoroughly Witzelizing the large tube and fastening it to the peritoneum with the single catgut stitch, insures its remaining in place until its period of use is over. Then, instead of removal of the catheter by pulling it out of the wound, it is cut off close to the skin surface and allowed to pass out through the colostomy opening.

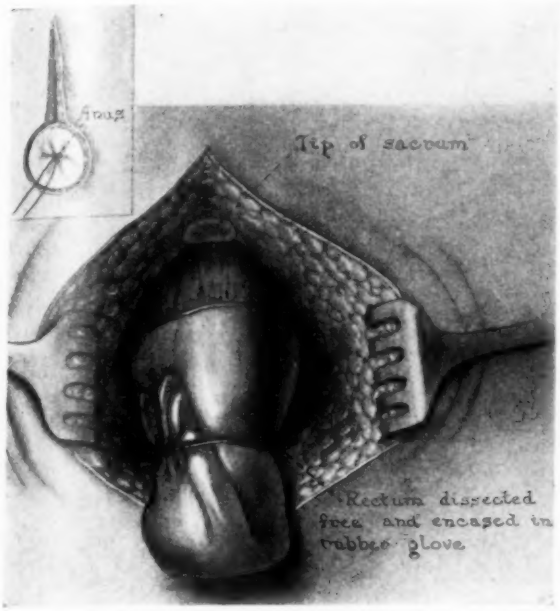

Fig. 4. Graded perineo-abdominal resection of the rectum and rectosigmoid, second stage. Insert shows anus closed with pursestring suture and encircled by two incisions which go up over the sacrococcygeal joint. The dissection is shown carried up to the peritoneal reflection, sacrificing the major portion of the levator ani muscle and clearing out the ischiorectal fossa. The coccyx is disarticulated from the sacrum. The rectum is encased in a rubber glove, thrust back into the hollow of the sacrum, and the wound closed.

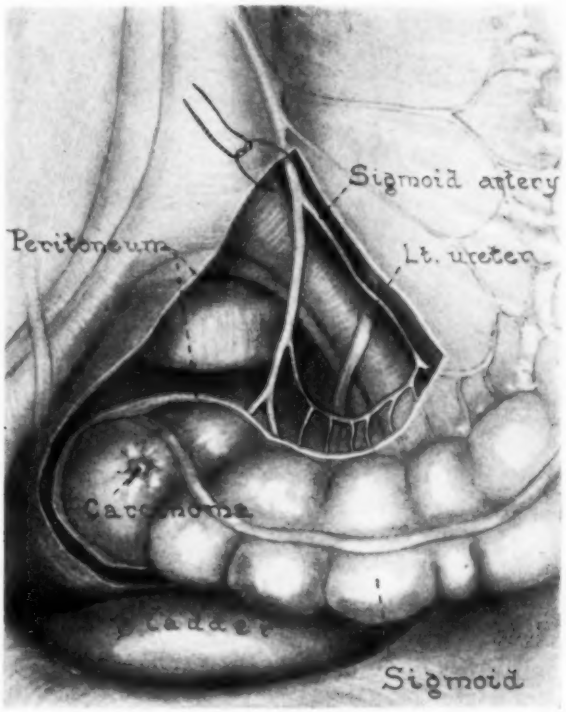

Fig. 5. Graded perineo-abdominal resection of the rectum and rectosigmoid, second stage. Abdomen has been opened again through the original low mid-line incision, both ureters visualized, and the inferior mesenteric vessels ligated accurately above the first sigmoid branch. The peritoneal flaps and new pelvic floor are demonstrated.

MANUFACTURE OF COLOSTOMY

With the sigmoid pulled well out through the low mid-line incision, a convenient spot in its mesentery is chosen and the blood vessels close to the bowel divided, but only sufficiently to permit the proximal end to be drawn out through a stab wound, while the distal end is inverted and dropped back into the peritoneal cavity. I emphasize that the looping arches of the vascular supply of the sigmoid should be carefully preserved and that only the little vessels which run off into the bowel wall itself be ligated under actual vision so that the blood supply to the two ends of the bowel be not interfered with. An objection to this type of colostomy is that occasionally an abscess develops in the lower end. I have seen one such abscess develop in one of my cases and David has reported a similar experience. However, in the vast majority of instances one will have no such difficulty and unless there is an enormous amount of fat in the mesentery, one can actually demonstrate whether or not the blood supply is impaired.

The bowel is divided between two Payr clamps, the upper one of which has been thrust through a stab wound in the groin selected as the site most satisfactory for the establishment of a colostomy, that is, where one's colostomy apparatus will fit the most conveniently. The second clamp is applied in the opposite direction and the bowel is cut across with a cautery. The proximal end is drawn out and the clamp left on, completely obstructing the bowel for twenty-four to sixty hours when exudate seals it snugly from the peritoneal cavity.

Recently I have been using, in this stage, the Cope modification of the Martel clamp which has proved very satisfactory in saving time and sutures. The distal loop is inverted and dropped back. Sutures are not placed in the bowel wall to attach the colostomy to the peritoneum. The stab wound is made through the musculature of the abdominal wall and is only large enough to permit the bowel to be pulled out easily, and insures against prolapse of the mucous membrane of the bowel and herniation around the opening. A single-barreled colostomy through a stab wound, if one is careful to pull down all the "slack" in the sigmoid, answers all the requirements and is far more easily cared for than the loop variety. The establishment of correct bowel habits, the proper attitude of the patient toward the care of his colostomy, and a dietary regime which insures formed stools emptied once or twice a day, minimizes any discomfort which such a companion might produce.

SECOND STAGE: PERINEO-ABDOMINAL RESECTION

After the establishment of a single-barreled colostomy or cecostomy, a period of rehabilitation of from two to six weeks is desirable before attempting the removal of the distal segment containing the cancer. During this time rectal irrigations are instituted from about the tenth day until a day before the second stage. By using a two-way rectal tube the bowel is cleansed without undue pressure on the stump and the warm solution used, plus the by-passing of the fecal current, assists in reducing the inflammatory reaction around the growth.

Rehabilitory measures are instituted simultaneously and one may experience a satisfactory improvement after relief of the obstruction has been accomplished. The actual resection is a perineo-abdominal type of procedure beginning with the patient face downward on the table as for a posterior type of resection with the hips elevated and the anus closed with a purse-string suture. Encircling the anus with two incisions which join and extend up to about the middle of the coccyx, an extensive dissection of the pelvis up to the peritoneal reflection is accomplished.

The objects of this maneuver are two: first, to avoid a certain amount of shock which a prolonged abdominal operation

entails, and second, to clear out the hollow of the sacrum and the ischiorectal fossa, and remove a large portion of the levator ani muscle. This also allows for the cleaning away of the gland-bearing tissues around the prostate and seminal vesicles in the male and the posterior vaginal wall and cervix in the female. This dissection follows disarticulation of the coccyx from the sacrum and the division of the fascia propria opposite this joint. The dissection of the tissue in the hollow of the sacrum is a blunt one, done with the gloved hand. The lateral dissection on each side is carried completely up to the peritoneum without opening it. The rectum at this point is encased in a rubber glove which is tied tightly around the cuff, and pushed back into the hollow of the sacrum, and the posterior wound closed.

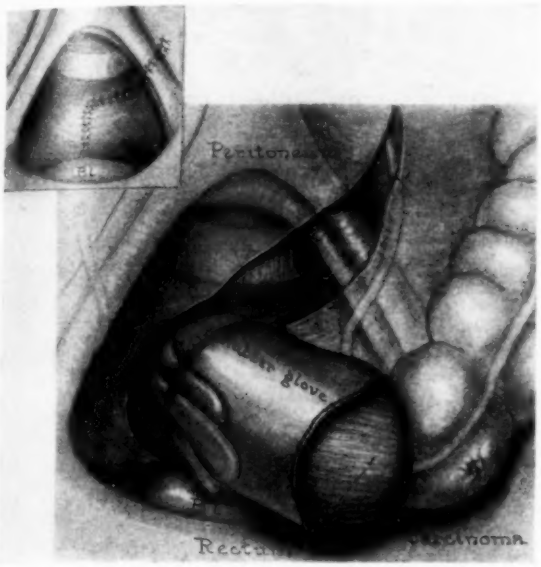

Fig. 6. Graded perineo-abdominal resection of the rectum and rectosigmoid, second stage. The dissection has been completed, the segment of bowel is being lifted out from the pelvis. Insert shows new pelvic floor manufactured from the peritoneal flaps.

This stage of the operation is carried on under trans-sacral block anesthesia, but after the patient is turned on his back and the abdominal part of the operation is to be undertaken, ethylene or gas-oxygen and ether anesthesia is employed. The latter part of the second stage, or the abdominal portion, is carried out quickly and easily through a low mid-line incision which is an enlargement of the one used for exploration. There is no necessity for exploration at this time and the operation is done entirely within the pelvis which is packed off with gauze. After locating the turned-in loop of bowel, the peritoneum over the inferior mesenteric vessels is incised and after identification of both ureters, these vessels are doubly ligated close to their origin. Excepting only the middle sacral artery, the terminal branch of the aorta, practically all of the blood supply is thus tied. The peritoneal incisions are now carried forward toward the base of the bladder on both sides and the latter organ is separated away from the rectum. With gauze dissection, the gland-bearing tissues on both sides of the bowel are wiped mesially and the entire segment is lifted out through the abdomen.

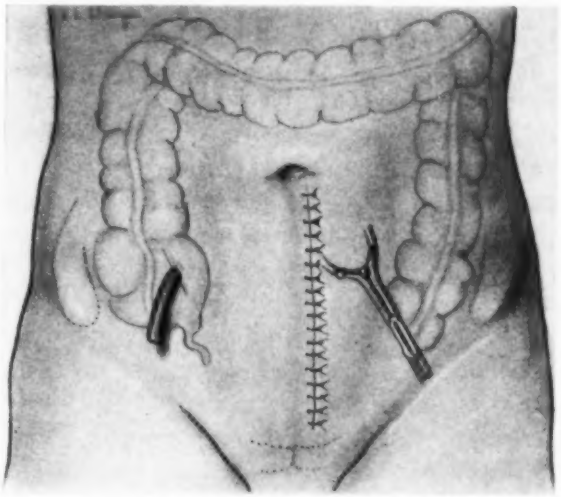

Fig. 7. Graded perineo-abdominal resection of the rectum and rectosigmoid, second stage. Completed operation. The cecostomy tube is shown in situ where a preliminary cecostomy has been done. The newly manufactured colostomy is shown held in a Payr clamp which is removed at the end of twenty-four to sixty hours.

There is little or no difficulty in restoring the pelvic floor with the peritoneum which has been saved. Should there be any trouble in accomplishing this step in the female, the broad ligaments and the uterus may be substituted to close any defect. The abdominal wound is now closed and the

drainage of the pelvis is made by opening the posterior wound and inserting a quantity of gauze encased in oiled silk. If one thrusts this oiled silk into the hollow of the pelvis and then packs the gauze tightly into it, several purposes are served. First, oozing is controlled; second, support is afforded the newly made pelvic floor; third, by the use of the oiled silk, the removal of the gauze packing is simple and painless. It is my custom to take all of the drains out of the posterior wound at the end of sixty hours and then to institute daily irrigations of normal saline, and at the end of ten days allow the patient to get into a sitz bath. This large cavity heals by granulation in a surprisingly rapid manner in most cases.

The second stage of the operation is not particularly tedious or difficult and while it has the disadvantage of opening the peritoneal cavity twice in a short period, it employs the fundamental principles of a radical operation and extends the scope of operability without influence on the mortality.

This type of perineo-abdominal resection in two stages has proved a very acceptable choice of operation in many cases of rectosigmoidal cancers in my hands during the past five years. To Grey Turner of Newcastle-on-Tyne should go the credit for originating it. He reported seven such successful operations in 1920. Gordon-Taylor and Gabriel, both of London, are impressed with its utility and the latter finds among its advantages definitely less shock, and apparently feels that it is a much simpler technical procedure than a formidable single-stage resection.

Because of these advantages, I feel sure that one may safely surmise that it is another weapon in the armamentarium of a surgeon which may be employed in specially selected cases, particularly where the obstruction has been unsatisfactorily relieved by preliminary medical measures. That there is less shock seems to me to be true, and consequently I have felt that its application to the more advanced cases is indicated without accepting any one type of procedure as a routine.

PREOPERATIVE PREPARATION

With the exception of that group of cases which appear as acute intestinal obstruction and are later found to be caused by cancers of the rectosigmoid, surgery for the extirpation of rectal and rectosigmoidal carcinomas may be undertaken at a definitely selected time. The fact that most carcinomas of the rectosigmoid, as well as the rectum proper, produce some type of obstruction and consequently quickly undermine the individual's physiologic equilibrium, makes the institution of preoperative decompressive measures essential.

Repeated irrigations of the bowel with hot saline and at the same time carefully supervised administration of such mild purgatives as senna, usually accomplish the cleansing of the colon. This is further assisted by the maintenance of a diet high in calories and low in residue. If one persists in carrying out these measures over a period of five to seven days, almost invariably a clean, flat colon will be found on exploration, but where, despite all efforts the obstruction still persists, surgical decompression by cecostomy is indicated.

During the period of decompression, rehabilitory measures which increase the safety factors are instituted. Preoperative administration of an intraperitoneal vaccine of mixed streptococci and colon bacilli has, I feel, proved its value as one of the steps in the sequence of events aimed at preparing an individual to withstand a potential peritoneal contamination.

Theoretically it seems a practical step to use this vaccine, and yet absolutely accurate control and prevention of contamination is not entirely sure. A fair ground as regards intraperitoneal vaccination seems to be that it is advantageous in conjunction with the other measures, but alone its utility seems distinctly questionable. Decompression, the most

important fundamental, and rehabilitation by all available methods, particularly the institution of blood transfusions in many cases, are two cardinal features of the preliminary preparatory program.

ANESTHESIA

A most important consideration in dealing with cancer of the rectum and rectosigmoid, whether the operation be accomplished in one or two stages, is the question of anesthesia. That the ideal anesthetic has not been evolved seems an obvious truism, but I have found great comfort in gas-oxygen and ether for the exploration and establishment of whatever decompressive measure seems advisable, and for the second stage, trans-sacral block anesthesia for the perineal procedure and gas-oxygen and ether or ethylene anesthesia for the completion of the abdominal stage of the maneuver.

With increasing knowledge of methods and types of anesthesia, and with more adequate preliminary premedication, one feels that the margin of safety has been unquestionably increased, yet the complete avoidance of pulmonary complications secondary to any anesthetic is still a hope rather than an achievement. Spinal anesthesia, which I employed routinely over a period of years, has been abandoned in my service, although I feel that there must be a place for it in this field of surgery, the indications for which, however, are not clear to me.

POSTOPERATIVE TREATMENT

Postoperatively it is inadvisable to give fluids by mouth for a period of forty-eight to sixty hours. Narcotics are supplied for comfort and to quiet peristaltic movements. It has been my custom to begin giving fluids by mouth when the individual begins to pass gas through the colostomy, and until this time to insure hydration by the administration of 3000 to 4000 c.c. of fluids by hypodermoclysis and venoclysis. Routinely after resection, a single blood transfusion of 500 c.c. of blood is given and repeated during the convalescence if it seems essential. That this has had a beneficial effect, promoting a smoother and less complicated convalescence, I am sure.

The posterior packing is removed at the end of sixty to seventy-two hours and warm saline irrigations are instituted. Sitz baths are begun on the tenth day. At the end of two to three weeks the wounds are usually fairly well healed, and complications are treated symptomatically as they arise. Especially should one be on the watch for the development of parotitis which seems to be an unusually frequent complication following operations on the large bowel and rectum; it occurs nearly seventeen times as often as in general surgical cases. Its early recognition and immediate treatment by radium packs prevents suppuration in the large majority of instances and avoids incision of the gland.

The attitude of the individual toward the care of the colostomy is important. We have long since abandoned all complicated apparatus and rely upon a simple elastic belt much like an abdominal supporter. This belt has placed in it, over the colostomy site, a removable rubber mat about 6 inches square. The colostomy should be irrigated and tended to once or twice a day if necessary, and dietary regime instituted to see that the stools are formed. The escape of gas is unavoidable but so long as the stools are formed there is little unpleasantness if the colostomy is properly attended to.

OPERABILITY AND OPERATIVE MORTALITY

The question of selection of cases for operation and operative mortality are intimately associated if one employs radical procedures for the extirpation of rectal and rectosigmoidal cancers. Operability is a vague term, elastic, and differing in interpretation in the hands of different surgeons. The equation is largely a personal one. In the absence of liver metas-

tases, the radical extirpation of any rectal or rectosigmoidal growth which is not too firmly fixed to adjacent structures, may be done with a mortality recognized as reasonable. I would urge that this operability be increased to take in all semi-fixed growths and borderline cases. So frequently one finds large cancers to recede under decompressive measures, or upon removal to be free from glandular metastases, that it is logical that one attempt to remove all such growths.

Operability figures vary, but 50 per cent is about the average in the hands of experienced surgeons. That one out of two cancers of the rectum or rectosigmoid may be removed by radical procedures with a 10 per cent mortality, is a distinct achievement of the recent decade. That radical surgery should be instituted for such growths in as many cases as possible seems logical when one considers that of the specimens removed at operation, 46 per cent show glandular involvement. Because of this fact, especially in rectosigmoidal growths, I have made every effort to employ the radical perineo-abdominal operation when possible. In my series it has been done 89 times with 8 deaths, a mortality of 8.8 per cent, and an operability rate of 50 per cent to 60 per cent. It is true, however, that no one type of surgery is adaptable to all cases of cancer of the rectum and rectosigmoid and that while the radical combined perineo-abdominal operation in one or two stages is, in the light of present-day knowledge, unquestionably the operation of choice, at the same time so many factors enter into the selection of an extirpative procedure that other operations such as colostomy and posterior resection or even less radical procedures give comfort and hope to a smaller percentage of patients.

SACROPERINEAL RESECTION*

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NEW YORK

THE resection of the ano-rectum through the sacroperineal space may constitute the second stage of an abdominal section with the extensive removal of the disease-bearing loop of colon; or it may represent the sole attempt at excision of a pathologic ano-rectum in one stage. In the first instance the patient is frequently, though not necessarily, left with an abdominal colostomy; in the second with a sacral anus. From the standpoint of thoroughness of resection the combined operation is unequaled; from that of personal comfort, mental relief, and conjugal happiness the one stage caudal section has much to recommend it.

The patient is placed in the recumbent prone or reversed lithotomy position with the buttocks slightly raised. The legs, extended, and thighs abducted and flexed at about 45 degrees, are allowed to rest on the foot-piece of the operating table. Spinal anesthesia is preferred in the absence of specific contraindications. The operative field is prepared with one-half strength tincture iodine or 95 per cent alcohol. Following anesthetization and preparation, the operation proceeds as follows:

1. A skin incision is carried about the anus and edges of sphincter sutured together. This portion of the operative field is re-prepared. Instruments and gloves are discarded before continuing with the second step. (Fig. 1.)

2. The skin incision is carried from the left border of the sacrum at the level of the spine of the second sacral vertebra obliquely downwards, to the right, and completely about the anus. The skin and subcutaneous tissue are reflected off from the posterior surface of the sacrum and coccyx. The lower two segments of the sacrum and coccyx are sharply dissected free from muscular (glutei maximi) and fascial attachments. A Gigli saw is carried upwards along the anterior surface of the sacrum and the sacrum divided between the third and fourth segments. The lower portion of the sacrum and the coccyx are then lifted off from the presacral fascia, levator ani, and sphincter ani, while the cut edges of the glutei maximi retract to the lateral extremities of the wound. The mid-sacral artery is ligated.

3. The incision is carried through the muscular fibers about the anal canal. The anus is freed from the prostate and the base of the bladder or from the vagina anteriorly. Any accidental incision of the bladder is at once repaired. The ano-rectum is followed upwards, care being taken to clamp the branches of the inferior and middle hemorrhoidal vessels and to remove, along with the rectum, the presacral fascia, fat, and lymphatics intact.

4. The superior hemorrhoidal vessels are clamped and ligated at the upper and posterolateral walls of the rectum. (Fig. 2.)

5. The peritoneum is opened at the lateral borders of the rectum where it appears to dip most accessibly. Its edges are clamped on the pelvic side as the incision is continued about the rectal wall.

6. The rectum is drawn down and the peritoneum re-sutured at the desired higher level on the rectosigmoid. If necessary the mesorectum is divided posteriorly to permit greater delivery of the rectum.

7. The diseased portion is excised, cutting between clamps with the cautery, and the lower end of the intact proximal loop is brought acutely backwards under the lower edge of the severed sacrum. Flaps of periosteum belonging to the fourth sacral vertebra left attached to edge of sacrum, are used to sling the free end of bowel to sacrum. This fascial wrapper and acute angulation of the bowel assist in the control of feces.

8. All bleeding points are secured. The

* From the Third Surgical Division, Bellevue Hospital, Arthur M. Wright, Director.

edges of the divided muscles are sutured with interrupted chromic gut. Fascia and skin are likewise closed with interrupted

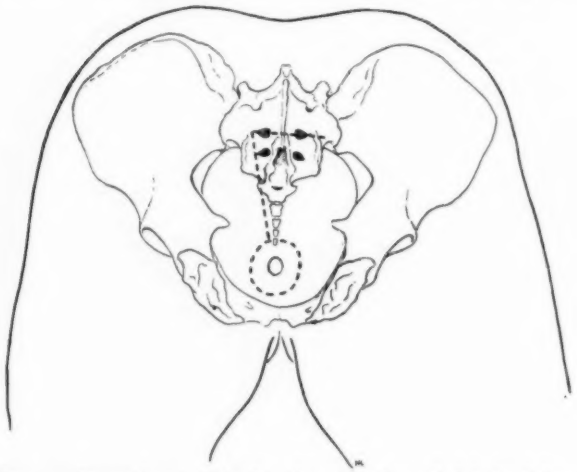

Fig. 1. Posterior pelvis showing relation of skin incision to bony landmarks. Also note osteotomy between third and fourth sacral vertebrae.

sutures. A Dakin's tube is left in each extremity of the wound; one at the anterior margin of the rectosigmoid and one in the anterior extremity of wound at the former site of ano-rectum.

9. It is essential to conserve the blood* supply for at this point the rectum is drawn out in redundant fashion on to the skin so as to overlap the skin edges about 2 cm. in its entire circumference. Sutures are placed between the edges of the flattened-out rectal wall and overlying skin. A vaseline gauze dressing is then applied. (Figs. 3 A and B.)

It is probable that sacroperineal resection should properly have a very limited application. Low lying rectal malignancies beyond which the examining finger may be placed completely and anal growths may be approached through this route. Similarly "pre-cancerous" lesions, benign tumors, and strictures or other inflammatory lesions requiring enucleation may be so treated. Local malignancies approachable from below, although they may be known to be widely metastasized elsewhere, may be submitted to sacroperineal resection and sacral colostomy as a palliative procedure. Finally there are those individuals who will not consent to an abdominal anus but who will undergo an operation for the establishment of a sacral colostomy. For these individuals it is felt that an early operation through the sacro-

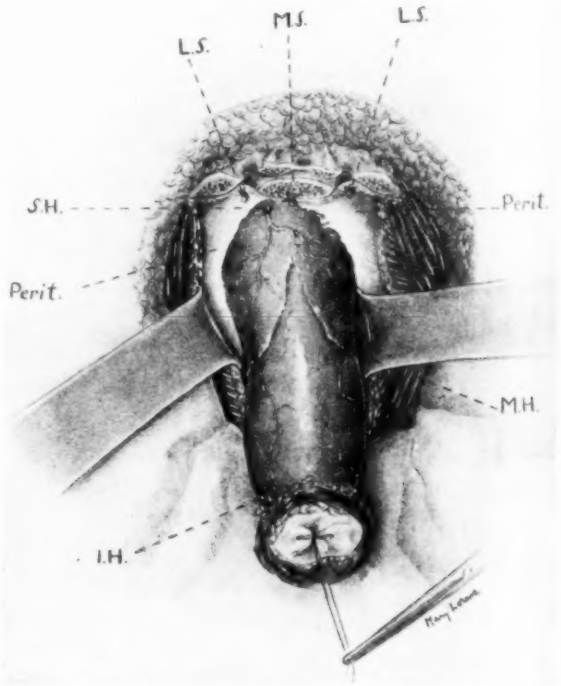

Fig. 2. Semidiagrammatic drawing showing dissection and delivery of ano-rectum. Note middle and lateral sacral, superior, middle and inferior hemorrhoidal vessels, lateral pouches of peritoneum opened, and rectosigmoid exposed.

perineal route is preferable to a late operation through the abdomen for the relief of intestinal obstruction.

These patients are completely worked up before operation. The condition of the heart, lungs, kidneys, and liver should be understood and each specific indication met. Glucose and saline solutions should be supplied and blood transfusions in selected cases. Most of these patients suffer from toxemias of alimentary origin and require thorough, but not depleting, cleansing of the intestinal tracts. Similar precautions should be continued after operation.

As soon as the patient has reacted from his anesthesia and operation he is placed on his side and off of his buttocks. This is essential to prevent undue pressure over the operative wound and sacral stoma. Dakinization is commenced the first postoperative day and continued a few days as a prophylactic against infection. Soft protective dressings and a good supply of kaolin are applied and frequently changed to

* The inferior mesenteric artery need not be ligated unless considerable bowel is to be excised.

keep the skin dry and allow lamp therapy.

From a review of the past fourteen years of the rectal carcinomata from the Third Surgical Division of Bellevue Hospital it appears that there are in all 128 cases. The great majority of these were hopelessly advanced at the time of admission. Some of these unfortunates came in to die on wards shortly after admission. Many others refused therapy of any kind and left the hospital after a brief rest in bed. Forty-five underwent colostomy of whom 10 patients were given radium implants and 3 had ileostomies performed. Radiotherapy was given in a large proportion of the later cases as a palliative without any hope of cure. There were but 13 abdomino-perineal resections and only 4 recorded sacroperineal resections.

Of the 13 who had combined abdomino-perineal resections, 4 died from one to eighteen days postoperatively and 9 survived. Of these at least one-third are known to have lived over three years. Of the 4 who had sacroperineal resections (Krasko), 3 underwent the "combined" operation and 1 was operated on from below only. Of the former, one succumbed of cardiac disease, with no evidence of metastasis, one year after operation; another was a remarkable case in that she became pregnant, was delivered of a normal child on the Obstetrical Division, survived this ordeal, and was suffering from a pulmonary tuberculosis three years later. The remaining two who had sacroperineal resections, at the present time, less than one year after their operations, are continuing satisfactorily.

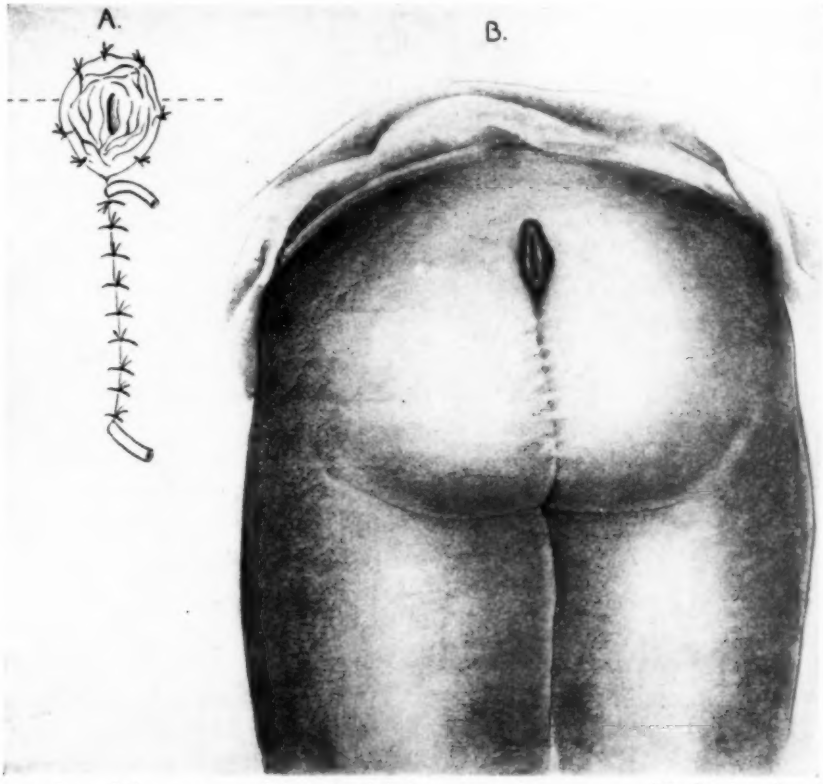

Fig. 3. S. B. Operated on July, 1934. A. Wound with interrupted sutures and Dakin's tubes in situ. B. Wound and sacral stoma four months later. Note relation of anus to edge of remaining sacrum.

CONCLUSION

In conclusion it is to be emphasized that the sacroperineal approach to resection of the rectum has been used in a small proportion of selected cases, approximately 3 per cent of all admissions or in one out of four of the resectible cases. This procedure has a certain usefulness in the non-resectible case as a palliative colostomy. Fecal continence has been more complete than in the abdominal colostomy. In the esthetic individual with pathology in the distal rectum it occasionally remains an operation of necessity.

PERINEAL EXCISION OF THE RECTUM FOR CARCINOMA

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NEW YORK

PERINEAL excision of the rectum is applicable for malignant disease limited to the terminal 3 inches of the rectum and the anal canal. The index finger should readily reach above the upper margin of the growth.

POSITION OF PATIENT

I generally use the lithotomy position with a slight elevation of the foot of the table. Some surgeons prefer the left lateral (Sims'), and others the "jack-knife" prone position of the patient.

TECHNIQUE

This varies with the situation of the growth. If its lower margin is more than one inch above the anal canal, the external sphincter may be preserved, but when the anal canal is involved or the lesion is an epithelioma of the anus, the sphincters must be sacrificed and the perianal skin removed widely. In males a stiff catheter is tied into the urethra to guard against its injury during operation; in females, the vagina is swabbed with 5 per cent picric acid solution.

EXCISION WITH PRESERVATION OF SPHINCTERS

Excision with Preservation of Sphincters. The rectum is sponged dry through a bivalve speculum. The field of operation is prepared with tincture of iodine followed by alcohol. To prevent contamination, the anus is closed by a purse-string suture of heavy linen passed just outside the anal verge, its ends left long to serve for traction. The point of ligation is phenolized and gloves are changed.

A circular incision is made 1 cm. outside the ligature and a cuff of the anal canal dissected up, exposing the external sphincter muscle, which is divided posteriorly and left in the lateral flaps. The incision is continued backward in the midline to the sacro-coccygeal joint and deepened in each ischiorectal fossa until the levator muscle is exposed. After the ligaments, fascia and glutei muscles at the tip and sides of the coccyx are severed, the bone is grasped with strong forceps and disarticulated. In some cases, especially in women with large pelves, the coccyx left *in situ* gives support to the pelvic floor. A pair of long heavy scissors curved on the flat is then passed into the retrorectal space and withdrawn with the blades open. Through the opening, two fingers are introduced, bluntly clearing the anterior surface of the sacrum and displacing all tissues of meso forward. The index finger is now hooked above the levator and its fascia, and they are severed on each side with scissors wide from the rectum. It is important to carry the incision of the levators well forward toward the midline. Bleeding, which is usually slight, is controlled by packing the cavity with a long strip of full width gauze folded to 4 inches.

The anterior margins of the wound are held forward with blunt retractors, while the rectum, drawn backward, is dissected free anteriorly. The successful accomplishment of the deeper portion of this separation depends upon following the anatomical plane of cleavage, which must always be identified and followed. Separation of the rectum from the vagina by blunt dissection is simple, but, in men, careful dissection is necessary to avoid injury of the urethra, prostate, seminal vesicles, and bladder.

The lower portion of the rectum is thus mobilized, but its upper portion is still

fixed by the lateral ligaments, peritoneum, and the vessels in the mesorectum. The packing is removed from the retrorectal space and the mesorectum is peeled from the sacrum up to the peritoneal culdesac. Any firm bands of tissue encountered should be divided between clamps. Next, the lateral ligaments are identified by touch and severed on each side between clamps to prevent bleeding from the middle hemorrhoidal vessels.

The mobilized bowel can now be drawn down, exposing the peritoneal pouch. Dissection of the rectum may end at this point, provided the upper margin of the tumor protrudes two or more inches beyond the skin surface. Unfortunately, this seldom occurs except in growths limited to the anal ring and terminal inch of the rectum. Usually, the growth approaches the peritoneal pouch which may be peeled from the rectum for a short distance without opening the pouch. As a rule, it is necessary to open the pouch. Gloves and instruments are changed. The protruding bowel is enveloped in a gauze laparotomy pad. The culdesac is opened and, with the index finger inserted as a guide, the peritoneum is cut with scissors close to the rectum on each side back to its mesentery. The latter is divided close to the sacrum to avoid injury of the superior hemorrhoidal artery. Following this technique from 6 to 8 inches of terminal bowel can be amputated.

When the length of freed bowel is sufficient to be brought down to the anus without tension 2 inches above the tumor, the peritoneum is closed by suturing it to the pelvic colon with interrupted stitches of 00 chromic catgut. Any bleeding vessels are tied or coagulated by applying the diathermy current for a moment near the tip of the forceps. Very few vessels need a ligature and the blood loss is surprisingly slight. The anterior space is closed with a few interrupted chromic sutures attaching the bowel to the tissues above the sphincter. When possible, the levator is sutured to the sides of the bowel. The sphincter (if it has been cut anteriorly) is sutured and the skin closed over the suture line with silkworm gut. The catheter

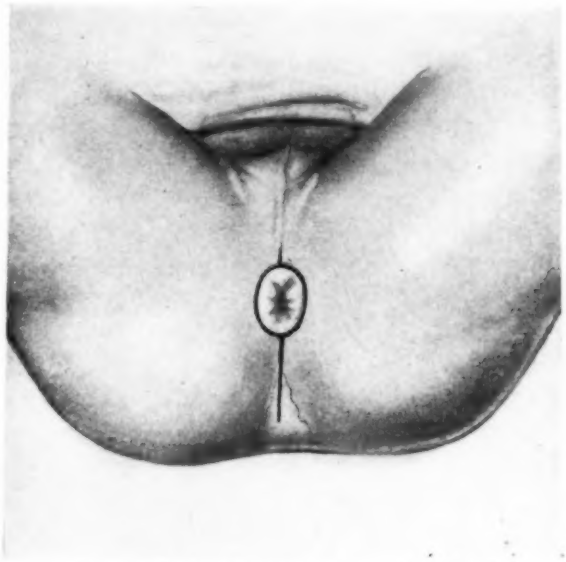

Fig. 1. Perineal proctectomy: Incision.*

is withdrawn.

Three Stewart stitches of heavy B.B. or silkworm gut are then passed transversely on a large curved needle just back of the protruding bowel to compress it snugly. The needle pierces the skin about one inch from the margin of the wound, is passed deeply and emerges at a corresponding point on the opposite side. In its return the needle pierces the skin only of both sides in the same plane ¼ inch from the wound margin. The suture is tied over ¼ inch rubber tubing to prevent excess skin tension. Correct placement of these sutures is important in restoring pelvic support.

During the suturing it is essential that a competent assistant support the protuding bowel, lest the stitches tear out.

Finally the bowel is amputated ¼ inch outside the anus. First all of its coats are divided with a scalpel down to the mucosa. The latter is caught in T-forceps as it is cut. The mesentery is clamped, cut and tied; otherwise, retracting vessels will

*The illustrations of this article are from the author's Treatise on Proctology, N. Y., Appleton, by permission.

bleed. Some bleeding is anticipated when the bowel is amputated. Its absence shows inadequate blood supply and the probability of the bowel sloughing. Careful note is made also of the distance of the line of amputation above the tumor. The mucosa is sutured to the skin with interrupted stitches of chromic catgut. A rubber tube is inserted about 5 inches into the bowel, its end projecting well

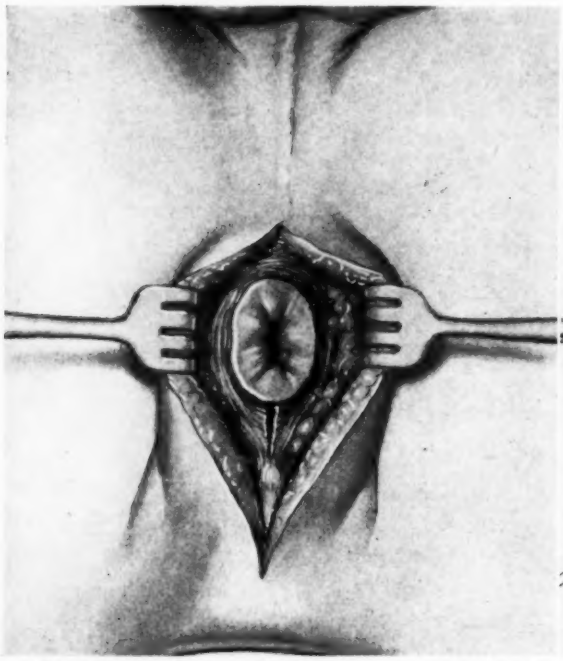

FIG. 2. Second step: External sphincter ani exposed and divided.

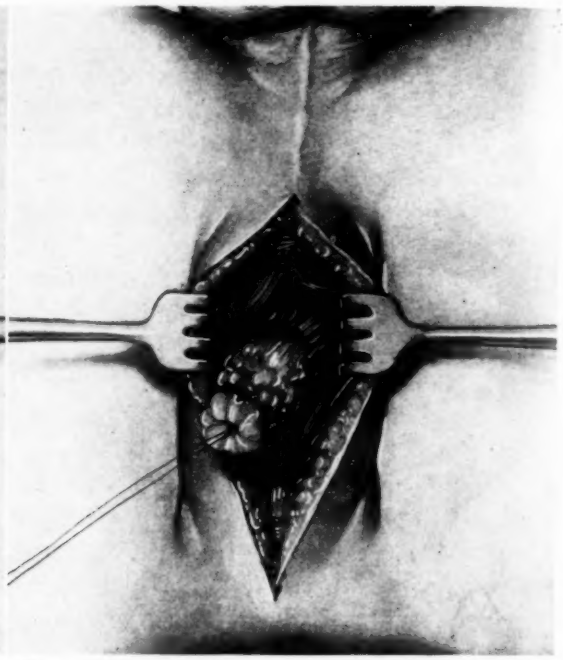

FIG. 3. Anus closed by a purse-string suture which also serves for traction.

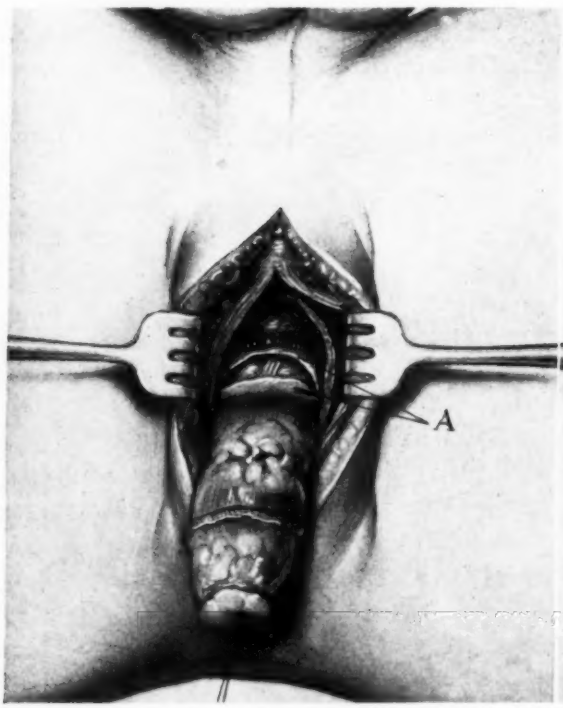

FIG. 4. A. Peritoneal pouch opened by a transverse incision, exposing pelvic colon.

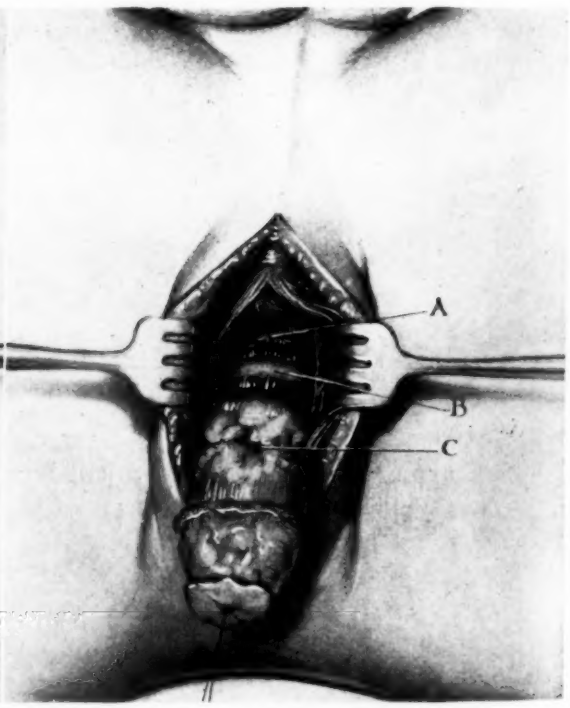

FIG. 5. Perineal proctectomy: A, prostate; B, peritoneal pouch; C, tumor.

beyond the outer dressing to prevent contamination of the wound by excreta.

A drainage tube of ½ inch caliber is inserted into the presacral cavity and gauze is packed lightly about it. Fluffed gauze is retained over the wound by strips of adhesive applied transversely while the patient's legs are extended. Over this a large pad of gauze is held in place by a broad T-binder.

Resection with Sacrifice of Sphincters. For epithelioma of the anus or a carcinoma involving the terminal inch of the rectum, wide excision *en bloc* of sphincters and tumor-bearing portion of the rectum is essential. For its accomplishment, I have found a "shield" incision very practical, to insure wide removal of skin, superficial fascia, and lymphatics. One carries transversely across the perineum an incision of 3 inches from each end of which curvilinear incisions meet at the tip of the coccyx. The dissection is carried out as in the previous operation, but as a shorter length of rectum is resected, it is frequently unnecessry to open the peritoneal cavity. Entrance to the anterior plane of cleavage in men is facilitated by identifying and dividing the rectourethralis muscle close to the urethra. After the gut descends a sufficient distance, the pelvic floor is partly restored by suture, the bowel amputated and its mucosa is stitched to the skin. Drainage tubes are inserted and dressings applied as in the previous operation.

COMMENT

Indications for Perineal Excision of the Rectum

a. Malignant disease of the terminal rectum, when the upper margin of the lesion can be reached readily with the finger, and for epithelioma of the anus. The latter, should be irradiated by gold seed implants of radon four to six weeks before excision.

b. Aged or debilitated patients, especially women, whose general condition interdicts more radical procedures.

c. Obese patients who lack resistance to major operations.

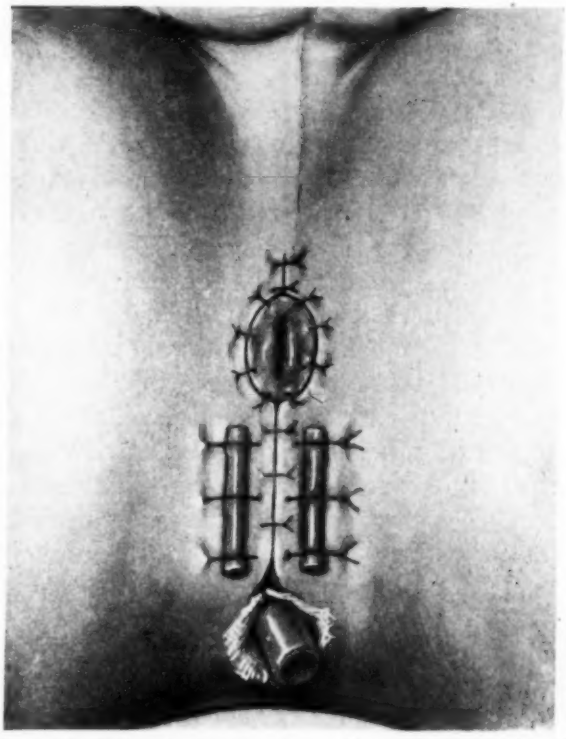

Fig. 6. Perineal proctectomy: Operation completed. For clarity, tube in rectum is omitted.

Preoperative Care. Patients in good condition require only two or three days of preparation, but the debilitated may require hospitalization for a week. During this period a concentrated diet is forced, drinking of water encouraged and oral hygiene attended to. To insure an empty bowel at the time of operation, a saline cathartic is given on three consecutive days, 40 c.c. of castor oil forty-eight hours before operation and daily rectal irrigations with potassium permanganate solution, 1:10,000.

Laboratory. Routine blood picture, Wassermann test, blood chemistry, and typing to anticipate transfusion before or after operation. A high sugar index of the blood or urine opposes radical surgery. In a woman, aged fifty-seven, diet and insulin freed the urine of sugar and reduced the blood sugar to normal limits, but the patient succumbed on the tenth day, gangrene developing in the wound.

An *x*-ray study should be made with barium clysma to determine the mobility and length of sigmoid available for operation.

Anesthesia. Neocaine spinal.

Postoperative Care. Shock and pain usually are slight after perineal excision. Opiates and sedatives are not given routinely but only on indication. Some patients void normally, but others have temporary retention of urine. For the latter, strict aseptic catheterization and urinary antiseptics are indicated. Fluids without milk confine the bowels from five to seven days. Evacuation is then obtained by injecting warm olive oil through the rectal tube and soap suds two hours later. The external dressing is changed p.r.n. The post-rectal drains are removed on the fourth day, and the wound is irrigated daily with 2 per cent boric acid solution or 1:10,000 potassium permanganate. A vaseline gauze drain is inserted after each irrigation. The skin sutures are removed on the sixth to the eighth day. The patient may sit in a chair on the tenth day and usually can return home three to four weeks after operation. Operative mortality varies from 10 to 15 per cent, and is due mainly to sepsis, shock, and pulmonary complications. The percentage is about 7 per cent higher in men than in women.

Continence depends in large measure on obtaining formed stools by dietary control. The British Ministry of Health (1927) classified continence in 398 cases of perineal excision as complete in 12.1 per cent, partial in 54.3 per cent, and incontinent 33.5 per cent.

Several of my patients have lived in comfort and without recurrence, five or more years after operation.

TECHNIQUE OF RADIATION THERAPY AND COLOSTOMY IN RECTAL CANCER

GEORGE E. BINKLEY, M.B. (TOR.)

NEW YORK

RADIATION therapy has been employed in rectal cancer for almost two decades, during which period there has been a gradual improvement in the methods of application and results. This improvement, together with increased knowledge of the various phases of cancerous disease, has placed this treatment in an important position as a curative and palliative measure in rectal cancer.

Radiation therapy is valuable in practically all inoperable cases, and is capable of providing a variable degree of palliation, characterized by lessening of symptoms, improvement of physical condition and feeling of well being; in many instances it assures an extension of comfortable life. Treatment by irradiation is not only a palliative measure, but it is also a method capable of producing clinical cures in properly selected, favorable and operable cases. It should not, however, be used routinely as a curative agent in all cases. It is a selected method for treating certain operable rectal cancers. Other selective methods worthy of mention are: one stage abdominal perineal operations; two stage abdominal perineal operations; and perineal resections with preliminary colostomy. Experience has proved that no one method of procedure is suitable for all patients with rectal cancer. Unbiased selection, the most adequate application of radiation therapy, and the afore-mentioned forms of recognized surgical technique are required to obtain the highest percentage of clinical cures and provide the greatest palliation in a miscellaneous group of cases.

METHODS OF IRRADIATION

The two methods of irradiation which have proved to be of greatest value in this disease are external irradiation and interstitial irradiation. External irradiation consists of applications of high voltage roentgen rays administered at 50 or 70 cm. from the skin, and of radium rays, obtained from a large radium pack, delivered at 15 cm. from the skin surface. Treatments are given daily about the pelvis at six or seven portals of entry, with rays directed to the tumor.

The most suitable form of interstitial application is the small gold filtered non-removal radon seed. Seeds are 3 mm. long, $^{75}/_{100}$ mm. in diameter, with a filter of $^{3}/_{10}$ mm. of gold. Strength varies from $^{1}/_{2}$ to 3 mc. each. These small capsules of radon are usually implanted into the tumor by direct vision through a lighted speculum by means of long trocar needles; the distribution is made so as to provide uniform dosage to all malignant cells.

Application of physical agents is not a difficult procedure, and may be carried out satisfactorily at any clinic with adequate facilities. Knowledge of the general principles of radiation therapy is essential. Cases may be properly selected when the surgeon is familiar with the following details: General condition of the patient in reference to ability to withstand treatment; extension of the disease; degree of infiltration and fixation of the primary lesion; location and accessibility of the mass for application of radon; degree of malignancy and radiosensitivity of the

cells; and finally the possibilities afforded by other forms of treatment. Important data of this nature are obtained by careful physical examinations, laboratory tests, digital and proctoscopic examinations.

Fig. 1. Implantation of gold seeds into a tumor situated low in rectum. Finger placed within rectum to guide distribution. Needles may be inserted by way of anal canal or through perineum.

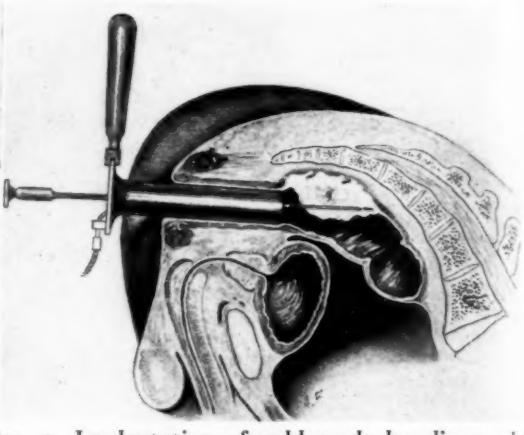

Fig. 2. Implantation of gold seeds by direct vision through an electrically lighted speculum. Patient in knee chest position.

The dosage of radium and roentgen rays required for a given case varies in accordance with the foregoing clinical and pathological findings. Analysis of such factors suggests three distinct groups of cases in which radiation therapy may be advantageously employed: First, favorable and operable cases in which one may expect a clinical cure by this method alone; a colostomy may be required to relieve obstruction. Second, operable cases in which preoperative radiation therapy offers advantages in promoting clinical cures. Third, advanced cases in which radiation therapy, either alone or combined with colostomy, offers the highest degree of palliation.

Favorable cases may be divided into two groups: (1) Very early, small, localized lesions that are accessible for adequate implantation of gold seeds. Colostomy is seldom required in these early stages. (2) Fairly large, extensive, local lesions, usually of low grade malignancy, which are accessible and so situated that adequate implantation of radon may be carried out. A number of such lesions are inoperable because of the general condition of the patient, or local extension of disease. A colostomy is frequently required to relieve the existing obstruction. The methods of application are the same in both instances, but the dosage of interstitial radon required for the large tumors is much greater than with the small lesions.

The first step in radiation therapy of the favorable group is external irradiation. The maximum dosage of roentgen ray that the skin will tolerate is delivered at two anterior, two posterior, and two lateral portals. When the tumor is low in the rectum, a perineal field is also included. The usual factors of such treatment are 200 kv., 30 ma., 70 cm., target skin distance, filter of ½ mm. of copper and 2 mm. of aluminum, with a portal 14 by 10 cm. An erythema dose of 850 roentgen units may be given at one time, or the divided dosage technique may be employed whereby an erythema dose is delivered by two or more smaller applications. For a number of years full erythema dosage to each portal was given daily or on alternate days at 50 cm. from the skin. Recently the divided dosage technique has been used in a percentage of cases and target skin distance has been extended to 70 cm. The latter technique appears to offer certain advantages. Since the average skin will tolerate repeating a dosage of 650 or 700 r within one week, it is thus possible to give the second pelvic cycle as soon as the first is

finished. In a number of cases, we are employing smaller dosage, and treating two portals the same day. This divided dosage is continued until the tolerance of the skin is reached.

The object of this preliminary therapy is to produce the greatest possible effect upon the primary lesion and adjacent nodes. Any favorable rectal cancer, suitable for radiation therapy alone, will show a marked improvement after external irradiation. There is a reduction in size, increase in fibrosis and decrease in infection and ulceration. These changes greatly facilitate calculation of dosage and application of radon seeds. In a few instances, less than 1 per cent of the cases, the disease will completely disappear after the maximum dosage of external therapy.

Radium rays may also be used for external therapy. However, because of the small amount of available radium, external radium irradiation can be carried out in only a few clinics. It is necessary to administer radium rays in divided doses. With a 4 gm. radium pack, 8000 mg. hr. at 15 cm. from the skin constitutes the daily dosage. The average skin will tolerate 75,000 mg. hr. at each portal. Because of the limited amount of radium, and the long time required at 15 cm. distance to deliver a skin erythema, radium is reserved for selected cases. In certain instances, employment of both radium and roentgen rays produces maximum results. When the two forms of rays are employed, the high voltage roentgen rays are given first, with dosage a little below an erythema to each of six portals. Radium rays are then delivered at two to four portals, with a dosage of about 50,000 mg. hr. at each portal.

The implantation of gold filtered radon seeds constitutes the second stage of radiation therapy. Applications are administered about a fortnight after completion of external treatment. Interstitial therapy is required to supplement the sublethal dosage of irradiation delivered by external applications. By varying the strength and number of the seeds, sufficient dosage may be given to eradicate either small or large tumors. The size and shape of the mass together with its radiosensitivity largely

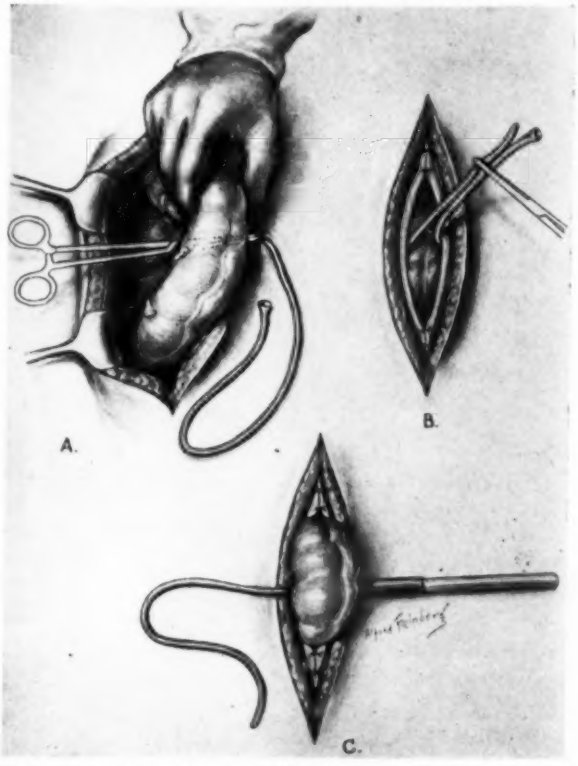

Fig. 3. Construction of colostomy. A. Forceps passed through mesocolon grasping tip of catheter. B. Catheter clamped. Bowel placed below peritoneum to facilitate closure. C. Wound partly closed. Sigmoid brought to surface. Glass rod placed in end of catheter ready to be drawn into final position.

determine the total dosage and the strength of individual seeds. Knowledge of the former factor is obtained by careful palpation and inspection, while the degree of radiosensitivity is estimated by histological study and by the amount of response to external therapy. Seeds varying from 1 to 2 mc. each are used in the more sensitive types; while seeds of 1½ to 3 mc. are used for the more radioresistant tumors. The total dosage will vary with the size of the lesion from 10 to 75 mc. The importance of selecting seeds of suitable strength for the given case and of distributing them within the mass in such a manner as to deliver a lethal dosage of irradiation to all malignant cells, cannot be overemphasized.

During the period of external therapy, patients need not be confined to the hos-

pital. It is, however, essential to have them in a suitably equipped operating room for interstitial implantation. Anesthesia for

Fig. 4. Colostomy constructed through a lower left rectus incision. Opening through abdominal wall permits insertion of finger.

this operation is seldom required. Seeds are usually inserted through a proctoscope by direct vision; occasionally, in low lying tumors, distribution is made by passing the finger within the rectum.

Prior to beginning implantation, all seeds are threaded into needles and made ready for insertion. Patients are placed in the position offering the best view of the tumor and making it most accessible. The proctoscope is passed, if possible, to the upper limits of the lesion. It is then withdrawn until the upper border of the malignant area comes into view. This uppermost area of tumor tissue is then implanted with gold seeds, with the insertions made ¾ to 1 cm. apart. The instrument is then withdrawn for a distance of 1 cm., and another row of seeds is implanted. This procedure is repeated until the whole tumor mass has received the required number of seeds, with the operative field meanwhile kept free of blood by means of a suction apparatus.

In the more advanced but still favorable cases, treatment differs slightly from the foregoing, for, while dosage and technique of application of the external therapy are the same, a colostomy is often required to relieve the partial obstruction. When an artificial anus is necessary, it is constructed prior to administering external therapy, or during the period elapsing between

Fig. 5. Implanting gold seeds into a stenosing tumor. Sigmoidoscope passed downward through colostomy opening.

external and interstitial applications. Such artificial openings, in addition to relieving obstruction, often facilitate the implantation of radon seeds into the upper inaccessible section of a stenosing tumor. A sigmoidoscope is passed downward into the lower loop of bowel to this area.

The combined treatment of radiation therapy and radical surgery is very suitable for a large group of borderline, operable rectal cancers. Preoperative radiation therapy may consist of external irradiation alone, or external irradiation together with gold radon seeds. External therapy is used alone when the disease is so situated that adequate application of radon cannot be carried out or when the latter procedure offers but little additional advantage. The field of usefulness for the implantation of radon seeds is chiefly with tumors situated below the reflection of the pelvic peritoneum in the middle and lower segment of the rectum.

The various steps of combined treatments are determined after appraisal of the various factors and are carried through in routine fashion. If only external therapy

is to be employed, a full erythema dose is administered to six or seven skin portals three weeks prior to operation. When both external and interstitial irradiation is advisable and the operative procedure of choice is a perineal resection preceded by colostomy, then patients are given the full erythema dose of external irradiation. Three weeks later a colostomy is constructed; one week following this operation of gold seeds are implanted, and the resection, or second operation, is carried out after seven to ten days. If the one-stage abdominal perineal resection is the choice of the surgeon, external therapy is the first step, followed in three weeks by implantation of gold seeds. Operation then is carried out seven to fourteen days later. When the tumor is to be removed, the dosage and the placement of the radon seeds differ slightly from those previously described. Radon seeds are inserted chiefly into the outlying areas of the cancer to be resected. The dosage is well above that generally required for devitalization. The object is to make double sure of devitalizing all malignant cells which cannot be removed by surgical dissection, thereby preventing a local recurrence, which in most instances is due to incomplete removal of the infiltrating malignant tissue.

PALLIATIVE TREATMENT

The first step of palliative treatment is also external irradiation. External therapy is used alone in the more advanced stages of the disease. In the less advanced stages, comparatively weak gold seeds are also employed. The possible degree of palliation and the method of application are largely determined from the clinical and pathological factors before treatment is commenced. When external therapy only is advisable, the preliminary course of treatment, consisting of six portals of high voltage roentgen rays employing ¾ to 1 erythema dose to each portal, is delivered in one or two applications with treatments daily or on alternate days. This suberythema dosage does not damage the skin, therefore it may be repeated at comparatively short intervals of one or two months.

Patients in whom the disease is favorable for a higher degree of palliation are given an erythema dose of roentgen rays or just less than an erythema dose to six or seven portals about the pelvis. Such dosage is administered by one, two, or more applications. Four to six weeks after completion of the external treatments, gold seeds are implanted into the mass. A sublethal dose is administered by implantation of seeds varying in strength from 1 to 1½ mc., with the object of curtailing activity, producing fibrosis, etc., without, however, subjecting the patient to undesirable radium reaction. The total dosage of radium used in the palliative stage varies from 20 to 30 mc. These applications of roentgen rays and radium will bring about a marked regression, or complete disappearance, of symptoms for periods varying from three to six months. Patients are examined at frequent intervals and are given one or both forms of irradiation therapy when the tumor shows signs of increased activity.

COLOSTOMY

A colostomy is required in about 50 per cent of the cases of rectal cancer treated by radiation therapy. In the face of complete or marked obstruction an artificial anus is imperative, but with minor degrees of obstruction it is optional. The effect of the physical agents is enhanced but little, by short circuiting. Many patients with this disease have been spared the inconvenience of an artificial anus, through the effects of radium and roentgen rays. Nevertheless, when short circuiting of the terminal intestinal tract offers an advantage to treatment in either the favorable or unfavorable cases, operation should not be withheld.

The ideal colostomy, when radiation therapy comprises the main part of treatment, is the double-barreled type. It can be quickly constructed with a minimum

amount of trauma and exposure to infection. The operation produces little shock and is followed by a low mortality. The small opening on the surface, connecting with the upper and lower loops, permits satisfactory cleansing of the whole colon and rectum. Moreover, when necessary, it provides a route for implanting radon into the upper limits of a stenosing tumor.

Preoperative preparation to reduce stasis and intoxication is important. The colon is cleansed by mild saline cathartics and irrigations for a few days prior to operation. Patients are given an easily digestible diet and plenty of fluids. Those in poor physical conditions are benefited by blood transfusions.

Spinal anesthesia is ideal for this operation. It provides perfect relaxation and permits detailed exploration of the abdominal cavity. By opening the abdomen through a left lower rectus incision, sufficient in length for careful exploration, the artificial opening is placed in a position that is accessible for cleansing and care. Herniation in such an incision is rare, but herniation about a colostomy is more likely to be due to an improper closure and infection of the wound than to its location.

Construction of a colostomy consists in bringing the sigmoid colon through the abdominal wound, passing a glass rod through the mesocolon and closing the wound in layers. At times numerous adhesions fix the sigmoid colon to the lateral abdominal wall. In many instances it is necessary to separate these adhesions before this section of gut can be delivered through the wound. The site for the opening in the sigmoid must be carefully selected. When such an opening is to be employed for the insertion of gold seeds, the length of the bowel between the tumor and the opening is left as short as possible without undue tension. If gold seeds are not to be inserted in this manner, the opening is placed in the upper portion of sigmoid near the junction of the descending colon, thereby placing the redundancy below the opening. The wound should be carefully closed in order to prevent weakening. The edges of the peritoneum are united with a continued stitch, starting from the upper and lower limits of the incision. An interrupted stitch is placed adjacent to the bowel, but the wall of the gut is not included. Fibers of the rectus muscle are united with plain catgut; the fascia and skin are closed with interrupted sutures, with no attempt to fix the bowel to the wound. Neither is the sigmoid attached to the left lateral abdominal wall. The opening through the abdominal wound is sufficient in size to admit the two loops of bowel in addition to the index finger. Large openings are often followed by prolapse of either the upper or lower loops, while very small openings frequently prevent satisfactory evacuations.

In order to facilitate closure, especially in obese subjects and in those suffering from obstruction, it is often advantageous not to place the glass rod through the mesocolon until the peritoneum is partly closed. Under these circumstances a catheter is passed through the mesocolon, clamped at the end and the bowel placed within the abdominal cavity. After partial closure the catheter is drawn through the wound together with sufficient bowel so that the under surface rests at the level of the skin. The closure of the muscle, fascia, and skin is then completed in the usual manner. After closure of the wound, a small wick of iodoform gauze is placed at the side of the bowel down to the fascia, to facilitate the drainage of serum. The section of the gut protruding is covered with vaseline gauze and the outer dressings arranged.

Postoperative care consists of hypodermoclysis twice daily for twenty-four hours, with no fluid taken by mouth. The dressing is changed and the wick of iodoform gauze removed twenty-four hours later. The colostomy is opened on the second postoperative day, and on the fifth, the patient receives a mild cathartic. Daily irrigations are commenced one week after operation.

A STUDY OF 78 PATIENTS WITH HYDATIDIFORM MOLE*

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THIS presentation is a study of 78 patients with hydatidiform mole occurring at the Lying-In Hospital of the City of New York from 1898 to 1932, a period of thirty-four years.

ETIOLOGY

The causative factors of this disease should be mentioned as they are still controversial in character. Hydatidiform degeneration has been considered to be either ovarian, endometrial or chorionic in origin.

There are those who are of the belief that it is due to an interference in the development of the corpus luteum of pregnancy with the formation of lutein cystomata. This group contend that such interference in the normal development in the ovaries results in hydatidiform degeneration of the villi of the placenta. If lutein cystomata is the cause and not the result, the relationship of the hormones in the sexual cycle, at present believed to be the most logical conception, cannot be accepted.

The endometrial theory is difficult to accept. Williams discredited this theory since it is based on animal experimentation. He felt that the fundamental differences in the structure of the placenta in dogs and in that of the human are of such a character that positive deductions should be accepted with caution.

Marchand's theory of chorionic origin is the one usually accepted. He believed that the condition was the result of a pathologic change in the epithelial layers of the chorionic villi, involving the syncytial and Langhans cells, as well as the endometrium in which the mole is imbedded. There is a disappearance of the terminal vessels of villi, a degeneration of the stroma and proliferation of the epithelial layers. These latter changes occur in varying degrees. The chorionic theory seems to be a logical one. It accounts for all the pathological changes found in the ovary, chorion and endometrium. It is believed that the ovarian changes are produced by the trophoblastic cells through their influence on the anterior lobe of the pituitary gland. This theory would also account for the hydatidiform degeneration found in twin pregnancies where one foetus is well developed.

These theories with respect to causation and pathology of this disease are so well described in the standard works on obstetrics that any further comment is superfluous.

FREQUENCY

In our study there were 78 patients with hydatidiform mole in 182,119 pregnancies during the period from 1898 to 1932, a frequency of 1 in 2334. One of these moles occurred in a tubal pregnancy. The frequency has been mentioned in the literature as from 1 in 200 to 1 in 2000. The latter figure is accepted by Polak as being more nearly correct, while Williams believed it to be slightly more frequent. The excessive frequencies occasionally recorded are based on microscopic findings only, which in many instances present only part of the pathological conditions requisite towards a diagnosis of this disease entity. This fact should be especially considered if the frequency of hydatidiform mole is

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to be properly evaluated. In our series the diagnosis was made macroscopically as well as microscopically.

CHORIOEPETHELIOMA

Many obstetricians are of the opinion that the occurrence of chorioepithelioma is a frequent sequence to hydatidiform mole. It is of interest that only one patient with chorioepithelioma was found in 182,-119 obstetrical and 14,280 gynecological patients. This malignant disease did not follow hydatidiform mole.

The infrequency of this disease has been repeatedly stated in the literature. Symmers noted only one chorioepithelioma in 12,000 autopsies; Lynch reported 7 in 2700 autopsies in the General Hospital of Vienna; Polak observed 10 patients with chorioepethelioma over a period of ten years; none having had a previous history of hydatidiform mole. In the same period he saw 50 patients with hydatidiform mole, and upon further investigation of 92 per cent of these no chorioepithelioma was found to be present. Others have reported similar findings. In the composite series of Giglio, Kehrer and DeLee totaling 94 patients with hydatidiform mole, no subsequent chorioepithelioma was recorded. Sturgis recently reported that 10 patients whom she had observed over a period of ten years did not develop chorioepithelioma following hydatidiform mole.

In our series we were able to follow up 12 patients for a period of two years. Eleven of these did not develop chorioepithelioma. One had a chorioepithelioma eighteen months after the expulsion of the original mole. But it is important to add that this patient had had an incomplete abortion in the interim before admission to the hospital. Because of the incomplete abortion in the interval, it is felt that this malignant disease was subsequent to the abortion and not secondary to the mole eighteen months before.

Since only a small number of patients could be traced, definite conclusions cannot be drawn from this series as to the relationship between these two diseases, which are of the same genetic origin. On the other hand, one might state that more instances of this malignant disease should have been observed in 196,399 patients during a period of thirty-four years. Our figures agree with the statement made by Novak: "Hydatidiform mole is infrequent and chorioepithelioma is rare." He believes that chorioepithelioma occurs in only 1 per cent of the moles.

TABLE 1
FREQUENCY IN REFERENCE TO AGE

	Age (Years)	*Number*	*Percentage*
Lying-In Hosp.	Over 40	8	10.3
	Under 40	70	89.7
	20–30	52	66.
Bland	20–30	..	69.8
Dorland	20–30	..	41.1
Kehrer	20–30	..	38.
Findley	20–30	..	69.

Table 1 indicates that hydatidiform mole occurs most often between twenty and thirty years of age, and that 89.7 per cent in our series were under forty years.

Sunde in his series of 122 cases of mole found that it was present two and one-half times more frequently above forty years of age, should the total number of pregnancies above this age limit be considered. Along this trend of thought, it is of interest to state that Vassbuch and Vermelieu found 20 pregnancies in patients fifty years or over, 5 of these, or 25 per cent, having hydatidiform mole.

The frequency as determined by Sunde would have been of much more value than the age groups outlined in Table 1, but the difficulty in determining these figures is evident.

GRAVIDITY AND PARITY

This series confirms the often repeated statement that hydatidiform mole is less common in the first than in a subsequent pregnancy. In this series 73 per cent were multigravida. However, when the parity

instead of the gravidity is considered, (as Bland did in his series) the percentage drops to 56. Bland found that 67 per cent were multipara.

In reviewing these figures it is evident that this chorionic disease does predominate in multipara and multigravida. However, this should not be a significant factor in the diagnosis of this disease as 27 per cent were found to be present in primigravida.

DURATION OF PREGNANCY

In 70 of the 78 patients with hydatidiform mole, 27 aborted spontaneously or because of alarming symptoms required interference at the third month. In the remaining 43 patients, 42 were aborted before the sixth month, and one in the seventh month. These figures coincide with the accepted opinion that most patients abort or are aborted before the sixth month and only a very occasional patient persists beyond this period of amenorrhea.

FETUS

The fetus has been described as either absent, degenerated or a remnant. Velasco reported its occurrence as 7.5 per cent and Bland as 10.9 per cent. In this series the fetus was present in 7 instances, or 8.8 per cent. The size of the fetus varied from six weeks to three and one-half months. In only one patient was a twin pregnancy obtained, one being a mole and the other a fetus.

SYMPTOMS

Subjective. The subjective symptoms usually complained of were bleeding, pain, nausea, vomiting, and acute toxemic manifestations; and absence of life in patients pregnant five months and over.

Bleeding. As a rule, bleeding was intermittent and watery in consistency, having been originally initiated with a gush of red blood. The period of bleeding varied from less than one week to five months. It lasted for less than one week in 38 patients and from one week to five months in 33. There was no bleeding in 7 patients.

Pain. Pain in the lower abdomen was recorded in 34 cases.

Toxemic Symptoms. Though it is true that the foregoing symptoms were most frequently observed, namely: bleeding and pain, yet nausea, vomiting and toxemic manifestations occurred so often and with such propensity, that a diagnosis of either hyperemesis gravidarum or toxemia of pregnancy was made in a large number of the patients. The frequency with which these diagnoses were made warrants a more detailed discussion along these lines than is usual in the various articles on this subject.

Polak, Williams, Tweedy and Wrench, and Frank dismiss the matter stating that toxemia may accompany the chorionic disease, but assume this complication to be rather rare. DeLee gives a more detailed account. He observed that 3 of his 19 patients with hydatidiform mole were toxemic. Two of these were "albuminuric and oedematous up to the hips" and one suffered from hyperemesis gravidarum.

In our series, 23 patients, or 29.4 per cent, showed definite symptoms of either early or late toxemia. The symptoms were of such a character that in 12 an original diagnosis of hyperemesis gravidarum was made, and in 2 a diagnosis of toxemia of pregnancy. In studying the remaining 64 patients, 9 presented definite toxemic findings in their histories which warrants the inclusion of these cases in this group. In recapitulation, it may be seen that 17.9 per cent had an original diagnosis of some form of toxemia, but a more careful analysis reveals that actually 29.4 per cent had an accompanying hyperemesis gravidarum or toxemia of pregnancy.

In reference to the toxemia, the histories of 3 patients in this series are of sufficient interest to be included here in detail.

Case 1. No. 86562. A white woman, aged twenty-eight, married, was admitted to the hospital November 18, 1931. She was a gravida 2 and para 0. In 1929 she had a spontaneous

abortion at the seventh week of pregnancy. On this admission her expected date of confinement was April 7, 1932. The patient was transferred from another hospital with the following history.

"The patient was admitted to this hospital October 29, 1931 through our gynecological outpatient clinic with her chief complaint being "heart burn" for the past two weeks, 'bloody' urine, pressure pain in the lower abdomen since the beginning of pregnancy four months before. She also complained of frequent micturition for the past three weeks.

"*Physical examination* revealed a patient four months pregnant, ankles edematous, heart negative, hyperactive tendon reflexes, moist rales in the lungs and a blood pressure of 182/110. Subsequently the blood pressure varied from 168/108 to 168/118. She was placed on a high carbohydrate diet.

"The laboratory findings were: Blood Chemistry: Uric acid and urea N. normal on two different occasions. CO_2 44.7 and 46.6 volumes per c.c. Sugar: 56 and 86 mg. per 100 c.c. blood. Icteric index 30. Vander Bergh: direct ++, indirect +, frouchet ++. Wassermann negative. Sedimentation time: forty minutes. October 30, 1931. Urine: Specific gravity 1.030; albumin ++++; blood +, sugar negative, granular casts, W.B.C. in large number and R.B.C. on one occasion."

On admission to the Lying-In Hospital November 18, 1931 at 6:50 P.M. the patient was found to be extremely toxemic. She showed the following findings:

November 18, 1931: Pulse 100, blood pressure 180/105, fundus of the uterus 18.5 cm. above symphysis and soft, no fetal heart heard, abdomen markedly distended, icteric, and knee jerks +++. Tentative diagnosis: Toxemia of pregnancy, jaundice (acute yellow atrophy) and six months pregnancy.

November 19, 1931; Blood pressure 180/105, stools clay colored. She was icteric and had marked itching of skin.

November 20, 1931: Ophthalmic examination of the fundi negative, blood pressure 172/118, edema still present. Vaginal examination showed that the cervix was behind the symphysis and the presence of a large mass in the cul-de-sac. The diagnosis at this time was toxemia of pregnancy, hydatidiform mole and ovarian cysts.

November 21, 1931: The urine continued to be amber colored and stools clay colored, and skin markedly jaundiced and itching. The blood pressure fluctuated very little during her entire stay in the hospital.

The laboratory findings were: Urine showed solid albumin, bile +, no leucin crystals, but hyaline and granular casts and a tendency towards a low specific gravity. Blood chemistry: N.P.N. 30 mg., uric acid 3.4 mg. and creatinine 1.2 mg. per 100 c.c. of blood. Icteric index 8. Aschheim-Zondek test: positive in all dilutions up to 10 after seventy-six hours. X-ray: no fetal bones. Blood count: normal; hemoglobin 82 per cent and R.B.C. 4,490,000.

On November 23, 1931 at 2 P.M., five days after admission, a dilatation and curettage and packing were performed. This was followed by an oophorectomy. Gas, oxygen and ether anesthesia were administered. The patient expired at 11.40 P.M. November 23, 1931, nine hours and forty minutes after the operation. Death was due to postoperative shock.

Pathological report on the specimens obtained was: (1) a macerated fetus three and one-half lunar months; (2) hydatidiform mole; (3) bilateral lutein cystomata of the ovaries.

Case II. No. 64689. A white woman, twenty-seven years of age, born in Russia, gravida 2, para 1, was admitted to the hospital on October 15, 1925 acutely ill. The tentative diagnosis of her disease was pernicious vomiting of pregnancy.

The patient gave a history of two months' amenorrhea, emesis during these two months and a loss of 10 lb. in the six weeks previous to her admission. She also complained of vertigo, pain in the lower abdomen and polyuria.

She was observed for the next four days until October 19, 1925. She was found to be two months gravid and acutely ill. The fundus of the uterus extended 10 cm. above the symphysis and masses were felt on both sides of the uterus. The blood pressure was 122/70. The tendon reflexes were hyperactive.

The laboratory findings were: Urine: trace of albumin. Blood chemistry: urea N 55 mg. per 100 c.c. blood. CO_2 52 volumes per cent. Blood count: normal, 80 per cent hemoglobin, 4,200,000 R.B.C.

The tentative diagnosis was bilateral ovarian cysts and a two months pregnancy. The patient was operated upon on October 19, 1925 under gas, oxygen and ether anesthesia

and a bilateral oophorectomy was performed. The patient passed a mole the next day. She expired October 23, 1925, four days postoperative in shock. She went into shock during the anesthetic, respirations rose to 48, pulse 150. She never reacted from the operation.

Case III. No. 22178. A white woman, twenty-five years of age, gravida 1, para 0, was admitted to the hospital on April 2, 1912 with a history of staining for five weeks; and dyspnea, headache, edema of face and extremities for the one week.

The patient had been married four months. The fundus of the uterus was one inch above the umbilicus, suggesting a six to six and one-half month pregnancy.

On admission her urine showed 4+ albumin (10 gm. per liter), indican, hyaline and granular casts. The blood count was normal. Fundal examination showed a hemorrhage in region of macula in the right eye. Tentative diagnosis, albuminuria, possible hydatidiform mole and ovarian cysts.

The patient was operated upon four days after admission, because of marked albuminuria and hemorrhage in the region of the macula. The initial procedure was packing after dilatation of the cervix. The next day the packing was removed. In manipulating the cervix, vesicles were passed. A dilatation and curettage was done, followed by a hot sterile douche.

On the twenty-first postoperative day, the patient had a second operation for the bilateral cysts. Left oophorectomy and right partial oophorectomy were performed. Her subsequent course was uneventful except for a slight febrile period. She was discharged thirty-six days after admission. Twenty-one days after admission the hemorrhage observed in the fundus of her eye showed definite evidence of absorption.

It will be noted that in each patient the toxemia was a most severe accompanying factor; that palpable bilateral lutein cystomata of the ovaries were present and that two of these patients died. Incidently, it may be stated here that these were the only patients who died in the entire series. A detailed account of the significance of the polycystic lutein cystomata will be given later, as well as the appropriate course of treatment in cases in which this cystic complication appears to be of significance.

These histories are reported in detail to emphasize the amount of toxemia which may accompany this disease, also because of the two mortalities which were the only ones in this series.

SYMPTOMS

Objective. The objective signs most frequently elicited in the 78 patients were: absence of palpable fetal parts, no fetal heart sounds, soft boggy uterus with no fluctuation as in hydramnios, the increased size of the uterus relative to the period of amenorrhea, and the passage of vesicles.

Relative Size of Uterus. The uterus was larger in size than the corresponding period of amenorrhea in 58 per cent and smaller in 6.8 per cent. It is important to mention that in 35.2 per cent the relative difference was not apparent.

Vesicles. The vesicles, on the other hand, were an aid to the diagnosis in only 17 cases, 21.8 per cent, and this was true only after labor had commenced.

LABORATORY PROCEDURES

X-ray was used once. This was in a four and one-half to five months pregnancy. It revealed no fetal bones.

The Aschheim-Zondek test was used once and then only after the diagnosis was evident. The test was positive in a dilution up to 10.

The blood counts were recorded in only 45 patients; 28 of these were described as anemic; 19 before and 9 after the uterus was emptied. A transfusion was given to 3 patients, none of whom died.

LUTEIN CYSTOMATA

One of the most interesting complications encountered in this chorionic disease is bilateral polycystic lutein cystomata. This was found in 3 patients. A detailed account was given previously under the discussion of toxemia. The most significant finding was the extreme degree of toxemia, and the exceedingly poor condition for any major operative procedure. In the histories mentioned herein, it may be observed that

in all instances oophorectomies were performed. Two of these patients died as a result of the operation. The deaths were due to a major operative procedure being performed on patients who were too ill to withstand the shock. The third patient was not operated upon for the cysts until twenty-one days after removal of the uterine contents and then only because symptoms of pelvic discomfort appeared to warrant the operation. She recovered.

In view of the importance of this subject, a few words from the literature seem appropriate. This complication has been described as either an etiological factor, or an occasional or constant accompaniment. This condition of the ovary is only an occasional gross complication. In our series, it was present in 3.8 per cent. Williams had observed bilateral polycystic lutein cystomata in hydatidiform mole only once in his obstetrical experience. Stoeckel, Wallert and Seitz consider the ovarian changes a result of exaggerated trophoblastic stimuli. Novak, who bases his theory on the work of Aschheim and Zondek, and Smith and Engle, believes that the anterior lobe of the pituitary gland is the activating force and that the variation in the ovarian changes depends on the amount of the pituitary principle present. The anterior lobe of the pituitary gland is activated by trophoblastic cells. The hyperactivated anterior lobe of the pituitary gland causes the so-called hyperactio luteinalis, i.e., polycystic lutein cystomata of the ovaries. Novak says it is a constant pathological occurrence in all hydatidiform mole cases varying only in degree. If these theories are to be accepted, then the proper treatment for cysts of this type is evident. A removal of the activating force should result in a gradual regression of the cystic disturbance in the ovaries.

MORBIDITY

The morbidity is based on a temperature rise to 100.4°F. on two consecutive twenty-four hours exclusive of the first twenty-four hours post-partum. Eleven patients in 78 showed a morbidity, 14.1 per cent.

MORTALITY

The mortality was 2 in 78 patients, or 2.5 per cent. According to the literature, the mortality varies from 10 to 15 per cent. DeLee, in a combined report, which included the cases of Williamson, Gerson and Hertzman, reported the mortality to be 19 per cent. In his own series, it was 5.2 per cent. Findley's figure was 10.5 per cent and Gordon's 9 per cent. They considered hemorrhage and sepsis the most frequent acute cause of death in hydatidiform mole.

The two mortalities in this series occurred in patients who had a laparotomy for ovarian cysts. In no instance was hemorrhage or sepsis a factor. These two patients had marked symptoms of toxemia and were poor surgical risks. The proper treatment would undoubtedly have been conservative emptying of the uterus from below. The ovarian cysts would have regressed with the removal of the mole and would not have required laparotomy.

TREATMENT

Before recommending any more definite form of treatment, the methods employed during the period of thirty-four years should be enumerated, especially when one considers the excellent immediate results obtained:

1. No treatment was given to 3 patients.
2. The uterus was emptied by dilatation and curettage, either by curette or by finger accompanied by intra-uterine packing before and after the emptying, in 65 patients. Intra-uterine douches were administered to a few of the earlier patients in the series.
3. The uterus was packed previous to a dilatation and trachelotomy and was followed by curettage in one patient.
4. The uterus was packed in 2 patients. This was followed in one instance by emptying the uterus with a sponge forceps while in the other no subsequent treatment was given.

5. Vaginal hysterotomy was performed upon 2 patients.

6. Abdominal hysterotomy was performed upon 2 patients.

7. One patient had a vaginal packing and later the introduction of a bag, due to a mistaken diagnosis. Subsequently a dilatation and curettage were performed.

8. Bilateral oophorectomy was an accompanying operation in 2 patients. In one other patient, it was the sole operative procedure.

9. The tubal pregnancy was treated by salpingectomy.

TREATMENT SUGGESTED FOR HYDATIDIFORM MOLE

From this study, it may readily be perceived that splendid immediate results have been obtained in the treatment of hydatidiform mole under conservative methods, i.e., a morbidity of 14.1 per cent, and a mortality of 2.5 per cent. However, in spite of these figures, the following routine procedure in the treatment of hydatidiform mole is suggested:

1. All patients suspected of hydatidiform mole should have the following laboratory tests:
   a. A complete blood count
   b. A urine analysis
   c. A blood chemistry
   d. Blood typed and cross matched
   e. *X*-ray
   f. Aschheim-Zondek test.

The *x*-ray is of value in patients pregnant four and one-half months and over. It determines the absence or presence of fetal bones which should be observed at this time of parturition. To avoid any error in diagnosis based on the finding of absence of fetal bones, it is always advisable to take more than one exposure of the pelvic cavity, and also a lateral, as well as anterior-posterior view.

The Aschheim-Zondek test should be done on all patients. This test is valuable if the determination is a quantitative one, i.e., the highest dilution that will give a positive result. According to Ehrhardt the Aschheim-Zondek test in a case of hydatidiform mole was found to be positive in a dilution of 1 to 520. Any subsequent determination showing an increase in the dilution at which the test was originally found to be positive is pathognomonic of a malignant change, i.e., chorioepithelioma. This test should be done bimonthly for the first two months and then monthly thereafter for at least one year. Latent periods that are occasionally reported are questionable. From a diagnostic and prognostic standpoint this test is of utmost importance, and if properly performed will help materially to decrease the late cause of mortality accompanying this disease.

2. When the diagnosis is uncertain and such symptoms as toxemia or hemorrhage are not alarming, whether the patient is in labor or not, treat her conservatively. No specific treatment should be instituted except rest in bed.

3. When the diagnosis is certain and such symptoms as toxemia or hemorrhage are not alarming, treat the patient as follows:

(a) If the patient is in labor, treat conservatively, rest in bed, and permit spontaneous delivery of the mole.

(b) If not in labor, she should be forced into it by intracervical packing after rupturing membranes. Always attempt to secure as much softening and dilatation of the cervix as is possible before interfering. A dilatation of at least 6 cm. is desirable before evacuating the uterus and whenever possible a spontaneous expulsion of the mole is preferable.

(c) The uterine cavity should always be explored digitally after delivery of the mole. The uterus should be packed and a course of ergot given.

4. Whether the diagnosis is certain or uncertain and the symptoms are alarming, treat the patient as outlined below:

(a) Whenever possible empty the uterus with the least amount of instrumentation.

(b) With insufficient dilatation of the cervix, intracervical or intrauterine pack-

ing should be instituted to permit conservative emptying of the uterus. But whenever bleeding occurs through the packing remove same and secure sufficient dilatation (at least 6 cm.) either by dilators or anterior vaginal hysterotomy. The uterine contents are then removed by sponge forceps, dull curette or digitally, preferably by the last method. Always avoid a sharp curette during the acute stage of the disease. The uterus is subsequently packed and a course of ergot is given.

(c) In the event of excessive blood loss, a transfusion is essential. Conservation of blood is an excellent defense against sepsis and shock which are the main causes for the high immediate morbidity and mortality. A donor should always be available for patients with a tentative diagnosis of hydatidiform mole.

5. Curette all patients two weeks after delivery of the mole. The curettings should be thoroughly examined microscopically. The presence of villi are not in themselves any criteria for a radical procedure. The invasiveness of chorionic cells, their proliferation, and the absence of connective tissue core, plus the clinical history, should be properly evaluated in concluding the absence or presence of a chorioepithelioma. The quantitative difference in the Aschheim-Zondek test will also be of paramount importance in the diagnosis of a possible malignancy.

6. Avoid oophorectomy. The bilateral lutein cystomata will regress after removal of the mole.

7. Whenever chorioepithelioma is suspected, do not forget to *x*-ray the lungs to ascertain the presence of metastasis.

CONCLUSIONS

In summarizing the analysis of the 78 cases, these facts bear repetition:

1. Hydatidiform mole is quite infrequent, occurring once in 2334 deliveries.

2. Chorioepithelioma as a sequence to hydatidiform mole is most infrequent insofar as we were able to ascertain, i.e., only a follow-up of 12 patients.

3. The morbidity and mortality immediate to this disease were quite low, 14.1 per cent and 2.5 per cent respectively. The deaths were not due to hemorrhage or sepsis but rather to unnecessary operative interference, i.e., immediate laparotomy for the bilateral lutein cystomata.

4. Lutein cystomata of the ovaries should not be removed. Bilateral polycystic lutein cystomata of the ovaries were palpable in 3 cases, or 3.8 per cent.

5. The most significant clinical observation in this series is the unusually high percentage of some form of toxemia of pregnancy which accompanied hydatidiform mole, the incidence being 29.4 per cent.

6. It is believed that the disease, if handled properly, is not accompanied by the high degree of morbidity and mortality usually accredited to it. This takes into consideration both the immediate and late effects of this disease. At least proper handling may eliminate hemorrhage and sepsis, the two most frequent causes of death. The diligent subsequent observation for a period of at least one year may prevent the malignant entity chorioepithelioma (which at best is a rare sequence), from securing a firm foothold, thus rendering all treatment useless.

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[For Remainder of References see p. 247.]

CALCIFICATION OF THE TIBIAL COLLATERAL LIGAMENT

(PELLEGRINI-STIEDA'S DISEASE)

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THE tibial collateral ligament of the knee is not a distinct anatomic entity. The internal portion of the capsule of the knee joint is reinforced by numerous longitudinal fibers which extend from the medial condyle of the femur near the adductor tubercle to the medial border of the tibial shaft, posterior to the attachment of the semi-tendinosus tendon. Thus a rather broad flattened band is formed which is called the tibial collateral ligament. Over the medial aspect of the joint, this ligament is firmly attached to the internal semilunar cartilage. Proximally and distally it blends with the periosteum of the femur and tibia respectively. As a result of trauma, all or part of this ligament may become calcified. It is our belief that where calcification of the tibial collateral ligament is observed, we are dealing with a metaplastic process rather than with an actual bony separation.

CASE I. Miss R. H., graduate nurse, twenty-four years of age. On August 29, 1933, this patient was injured in an automobile accident. Examination on August 30, 1933, besides other injuries, revealed a slight edema of the right knee with marked tenderness over the internal aspect of the knee. The patient was able to be up and about with an elastic support to the knee. *X*-rays taken on September 2, 1933 (Fig. 1), showed no evidence of bone injury. There was no definite evidence of injury to the internal semilunar cartilage. The patient continued to be up and about but constantly complained of pain over the internal aspect of the knee joint. Motion at the knee joint, in time, became quite normal. *X*-rays taken on March 12, 1934 (Fig. 2), showed a small splinter-like area of calcification adjacent to the internal condyle of the femur. This area of calcification, noted about six and one-half months following the injury, is definitely absent on the *x*-ray taken four days following the injury. The associated symptoms at present are quite mild.

CASE II. Mrs. H. W., housewife, aged forty-seven. On December 19, 1933, this patient sustained a severe fall, landing on both knees and striking her left knee very forcibly. Both knees were swollen and painful for about one week. The right knee improved, but the patient continued to complain of pain in the left knee. Examination on February 10, 1934, revealed a slight thickening over the internal aspect of the left knee associated with considerable tenderness over the internal condyle of the femur. There was no fluid formation nor limitation of motion. *X*-rays at this time, about seven weeks following the injury, revealed a small calcified area adjacent to the internal condyle of the femur. (Fig. 3.)

CASE III. Mr. E. H., automobile mechanic, aged twenty-five. On September 2, 1933, this patient was struck by an automobile, his right knee being impinged between the bumper of the car and a post. His right knee remained painful and swollen for about six to seven weeks, and the patient has had a great deal of pain and limitation of motion at the joint since. Examination on January 19, 1934, showed considerable atrophy of the thigh muscles, a slight edema over the patella, a small tender scar over the internal condyle, and considerable limitation in flexion and extension of the knee. *X*-rays on January 19, 1934, about four and one-half months following the injury, revealed a small semilunar area of calcification over the internal condyle of the femur. (Fig. 4.) This patient's symptoms were due chiefly to muscle atrophy and lack of use of the joint.

In a study of these cases, we note the following:

(1) All give a history of trauma.

(2) All show a similarity in size, shape, and position of the calcified area.

FIG. 1.

FIG. 2. Case 1. Arrow points to area of calcification.

(3) All show a small space between the calcified fragment and the internal condyle of the femur.

(4) The evidence of calcification is noted in from seven weeks to about seven months following the original trauma.

(5) The *X*-rays of Case 1 show definitely that no calcification was present four days after the injury, whereas *x*-rays about six and one-half months after the injury show definitely an area of calcification in the region of the tibial collateral ligament. This is one of the very few cases reported where *x*-ray studies were made shortly after and long after the original trauma, showing the gradual development of the calcification.

Three theories have been advanced as to the development of calcification in the tibial collateral ligament:

Theory 1. It was the belief of Stieda that the calcification observed was due to a chipping fracture of the internal condyle of the femur, a small particle of bone being detached at the time of injury. The first case of our series refutes this theory, as no bone fragment was observed roentgenologically four days following the injury.

Theory 2. This theory presumes that a periosteal tear occurs at the time of injury, a "fractureless callus" being the result of periosteal injury. If this were the case, it

FIG. 3.

FIG. 4.

seems that a definite fracture should be more frequently associated with this condition. We would also expect the calcified fragment to be closer to the bone and even attached to the bone. *X*-rays show the fragment quite removed from the bone and operative observations on reported cases showed that the fragment was distinctly separated from the bone. If we were dealing with a periosteal tear, it would seem that the ends of the fragment would tend to blend into the bone. Furthermore, the constancy of the size, shape, and position of the fragment would point to some uniformly present anatomic structure undergoing metaplasia, rather than to a periosteal tear which may occur anywhere along the bone.

Theory 3. This theory presumes that trauma initiates a metaplastic process in the tibial collateral ligament, calcification or ossification of the ligament resulting. This is the theory the writers subscribe to for the following reasons:

(1) Cases operated on have shown the calcification to be within the tibial collateral ligament (Kulowski, Finder, and Riebel and Riebel).

(2) Anatomically, the tibial collateral ligament is a division of the joint capsule, being attached to the bones of the knee joint and blending with the periosteum. Is it not reasonable to expect tissue so intimately related to bone to respond to trauma with a metaplasia similar to that which periosteum undergoes when traumatized?

(3) The gradual development of the calcification observed by the writers and others (Riebel and Riebel) speaks for a metaplastic process.

(4) The absence of any evidence of bone injury in Case 1, four days after the initial trauma, and the presence of definite calcification six and one-half months after the initial trauma, indicate that some metaplastic process within the tibial collateral ligament was initiated by the trauma.

SUMMARY

A study of the histories, clinical and *x*-ray findings in the cases reported, has led the authors to conclude that calcification of the tibial collateral ligament is a metaplastic process, generally initiated by trauma.

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THE OPERABILITY OF GASTRIC CARCINOMA*

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MUCH has been written on the subject of gastric malignancy, and during the past three decades many procedures have been devised for its surgical treatment. Some progress has been made in the cure of this condition, and, it being entirely a surgical problem, it seems timely to re-emphasize a few of the cardinal points of the operability of gastric carcinoma. Patients have been neglected, both by themselves and by the doctor, because of the failure to heed early signs of trouble and because of the utter pessimism which exists regarding the cure of this disease. The interval between the earliest signs of indigestion and the diagnosis of cancer of the stomach is usually much too long. To remedy this unfortunate situation necessitates a more careful evaluation of the patients' complaints and more thorough laboratory and *x*-ray studies, regardless of the increased percentage of negative findings.

Since it is known that gastric carcinoma accounts for one-third of all cancer deaths in men and one-fifth of all cancer deaths in women, the surgeon realizes that he is facing a major problem. It is necessary, when discussing gastric carcinoma, to evaluate all predisposing causes of cancer. Whether the cancer results from ulceration or the ulceration results from cancer, the problem remains the same. It must also be borne in mind that malignancy may follow the various benign lesions, such as ulcer, adenomas, and polyps, in an appreciable number of instances.

In discussing the operability of gastric cancer there are three considerations of practical interest. First, it is most important to remove the lesion as soon as possible after its origin. Second, if timely removal increases the life expectancy and comfort of the patient, measures must be taken to augment the percentage of early diagnoses. Third, the surgeon should be familiar with the procedures which may be employed to insure the longest freedom from recurrence of the disease.

Since there is no definite group of symptoms by which incipient cancer of the stomach may be diagnosed, and the textbook picture being of no value, the patients as well as the doctors must be impressed with the necessity of careful analysis in all instances of gastronomic distress. The outstanding symptoms may be dyspepsia, bleeding, weight loss, anemia and weakness. Any lesion of the stomach, regardless of its size or position, should be looked upon as a possible malignancy, or as potentially a forerunner of this condition. Significant data in suspecting a malignancy are found in a short dyspepsia history, with diminished or lacking hydrochloric acid, and the location of the lesion near the pylorus and usually on the lesser curvature of the stomach.

These various signs should command a painstaking physical examination, which alone may determine the operability of the patient. The formation of good judgment as to surgical interference is furthered by the added findings of the "sentinal gland" in the left neck, nodules at the umbilicus, the presence of growth at the rectal shelf, or *x*-ray evidence of lung metastasis. Such findings indicate that metastases are widely

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distributed and, in the presence of ascites, the condition is usually inoperable, even beyond palliative measures. A palpable mass in the epigastrium, regardless of its size and lacking grossly scattered metastases, may or may not be a lesion which would indicate inoperability. A small growth may have vicious and widely disseminated deposits and, conversely, a large growth may have few, if any, metastatic involvements. Therefore, it is apparent that a patient who does not give evidence of these gross findings is a fit subject for an exploratory operation to ascertain the exact condition within the abdomen. After this careful examination and the exercise of mature surgical judgment, the decision is made as to whether the patient shall have a palliative type of operation or an attempt at radical removal of the growth.

Gastric ulcer, whether treated medically or encountered at exploration, is a serious problem. Fluoroscopic vision has shown that many large and small ulcers of the stomach have been healed. However, great responsibility is placed on the diagnostician when he decides to allow the suspected ulcer a chance to heal by medical regimen. He may, by repeated examination, conclude that the ulcer is simple and finally cure his patient without surgery. By delay he may allow an early carcinoma, usually amenable to surgical treatment, to become inoperable.

With the abdomen open and the lesion carefully explored, how are we to determine whether we are dealing with a simple ulcer or a malignancy? Usually preoperative decisions can be accepted as superior to decisions made during surgical exploration. The absence of metastases, the highly inflamed character of the lesion, the lack of the light gray color, and the hardness of the tumor usually bespeak ulcer. Even then, removal of a specimen or the lesion itself, for microscopy, may be necessary for correct diagnosis. The protruding ulcer at the lesser curvature of the stomach is usually benign, whether large or small, whereas the rare lesion at the greater curvature is probably never benign. In those patients having definite malignant lesions, it must be decided whether it is worthwhile to explore with the hope of removal of the growth. In such instances radical surgery offers the best chance for extension of life, even in those patients having some evidence of metastases.

In considering the surgical measures which can be used to insure the longest possible freedom from recurrence, we may group the patients into three distinct classes: those having a removable lesion, with or without proved metastases; those having a severe lesion and widely scattered metastases; and those frankly inoperable except for palliation.

There are certain problems which have a bearing on the success of surgical treatment of gastric cancer, these being preoperative regimen, anesthesia, and postoperative care. During the preoperative management of these debilitated patients it must be remembered that an emergency does not exist and that the patients may be carefully prepared for the operation. Obstruction, with the distorted body chemistry, inanition and weakness, should be dealt with by gastric lavages, copious amounts of glucose and saline given intravenously, and, in many instances, blood transfusions. When anemia exists these measures become progressively more important. Injections of glucose and saline during the period of anesthesia may minimize shock.

The type of anesthesia is a factor of importance. The choice can be made when the possible magnitude of the procedure is ascertained. Local infiltration will permit exploration to envision the size of the lesion and to determine, according to the surgeon's best judgment, what can be done. This may be augmented by inhalation anesthesia if further surgery is indicated. Spinal anesthesia, when given by a qualified anesthetist, will give the maximum relaxation and enhance the operability of the patient, unless nausea is induced by the traction of the upper abdominal

organs. The complications following spinal anesthesia are as great as those following inhalation anesthesia. Ether, alone or in combination with the various gases, probably remains the preferable anesthetic. Preoperative medication, using the barbitals and morphine or avertin rectally, enhances the efficacy of inhalation anesthesia. The avertin must be slightly acid and cannot be given at a temperature above 110°, else formic acid is produced, creating an irritation in the rectum. The intratracheal method of administering the anesthesia, with cautious pre-anesthetic medication, is perhaps the method of choice.

It is well to mention here the work of John C. Ruddock of Los Angeles in abdominal peritoneoscopy. This procedure can be advantageously used to determine the operability of the condition, thus possibly obviating the necessity for a larger incision. This may avoid long hospitalization and poor repair of the wound.

At exploration of the abdomen, the surgeon visualizes the pathology and it is at this time that his best judgment must be exercised. The lesion is examined as to its nature and characteristics. The size, location, involvement and spread of metastases must be ascertained. The factors decreasing the possibilities of removal are lymphatic extension, serosal involvement with perforation, and a microscopically ascertained high grade of malignancy. Most cancers are situated near the pylorus at the lesser curvature and may involve the stomach in any direction. If the growth has not extended to the esophageal-gastric junction, the chance of removal, at least for palliation, increases the operability. Enlarged glands adjacent to the growth may show inflammation only, thus enhancing the possibility of extirpation of the growth. Nodules, in the liver and if not too widely scattered throughout the omentum, should not be a contraindication for local attack of the growth, since there are many instances in which patients having nodules in the liver have been permitted several useful years following partial gastrectomy for carcinoma.

The operation of choice for gastric carcinoma is the Polya type of partial gastric resection, of all malignant lesions or premalignant processes situated in the prepyloric region without extension, allowing removal of a wide margin of healthy stomach beyond the growth. These patients may be classed in group one and are fortunate if this type of operation can be done without too much hazard. However, in some instances the growth may be highly inflammatory in character and therefore firmly attached to the surrounding tissues. In this case it may be possible to divide the stomach, suture the two ends, and do a modified Billroth operation at the first stage. At a second operation several weeks later, the diminished and now more accessible growth can often be removed. In the patients of the second group the growth may be left intact and palliation alone achieved. The question of palliative gastroenterostomy in these inoperable patients can be debated. It is my judgment that no surgeon has a normal right to do a gastroenterostomy for an inoperable lesion where obstruction does not exist, and certainly it is not a justifiable procedure where actual or potential obstruction exists at the esophageal-gastric junction. Nor is it good surgical practice to place a gastroenterostomy below a non-obstructive gastric lesion on the cardiac portion of the stomach. Total gastrectemy for a scirrhous type of lesion may well be commented upon, as it has been successfully accomplished in a few instances. But both the patient and the surgeon should realize the hazard of this operation, the mortality being well over 90 per cent.

Most unfortunate are those patients of group three, for whom gastrostomy or jejunostomy must be considered, wholly as a palliative measure. Such procedures are occasionally meritorious in order that the few remaining months of these patient's

lives may be made more tolerable because of the accessibility of fluids and food.

Postoperatively, the stomach must be kept free of collected fluids for several days. The stomach pump should be as much a part of the armamentarium as the stethoscope. Added fluids, glucose, and blood may all be necessary for rapid convalescence. The chest should be watched for evidence of embolic complications, as the use of the oxygen tent may prevent long morbidity, or even prolong life, especially when pneumonia is a factor. The heart must also have careful consideration, since the use of digitalis may be urgent because of myocardial disease.

CONCLUSIONS

1. We see far too many inoperable or borderline cases of cancer of the stomach.

2. More prompt recognition and early radical extirpation will increase the interval before recurrence or may promote a cure.

3. Benign precancerous lesions should be radically treated.

4. Palliative measures, when correctly applied, have a limited field of usefulness.

5. Extensive lymphatic or serosal involvement, with a high grade of malignancy, are factors decreasing the possibilities of long postoperative life.

6. The presence of glands at the umbilicus, in the neck, or at the rectal shelf speak against operability.

7. Most patients having cancer of the stomach should have the advantage of an exploratory operation. Peritoneoscopy is a valuable procedure in selected cases.

8. Preoperative care, anesthesia and postoperative management are important factors in the consideration of operability of gastric carcinoma.

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DIVERTICULA OF UPPER END OF STOMACH

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A REVIEW of the literature on the subject of diverticula of the stomach, particularly of the cardiac end, would lead one to infer that the condition was rare. When, however, 15 cases are seen in the course of two years there arises the query as to whether the condition is so rare, or whether if the upper end of the stomach, particularly that part in the region of the cardio-esophageal junction, were subjected to as close and careful scrutiny as the pyloric portion, more of these diverticula would not be discovered, and in some cases account for some baffling gastric symptoms for which we are unable to find a definite cause.

Mechanical difficulties associated with an inaccessibility of the upper end of the stomach make this part difficult to manipulate under the fluoroscopic screen and again make it difficult to obtain the correct position for a plate in order to show the lesion advantageously.

Most often diverticula in the upper end of the stomach are either at the cardio-esophageal junction or immediately above or below it. They occur more often on the posterior aspect of the cardio-esophageal junction, but do occur also on the anterior aspect along the lesser curvature of the stomach. Ravenal[1] reported a case in which two distinct pouches projected from the anterior surface of the stomach just below the esophageal junction in a woman sixty-five years of age.

Diverticula may also arise from the greater curvature but these cases are extremely rare. Freedman[2] reported a case in which a gastric ulcer high up on the greater curvature had perforated and a perigastric abscess sac had formed which roentgenologically closely simulated a diverticulum when filled with barium, but later autopsy showed that this was not a case of true diverticulum. At this time Freedman suggested the possibility that some of the cases of diverticula reported in the literature and not accompanied by either operative or autopsy findings might be cases of perforated ulcer similar to his case.

Borszeky[3] described 2 cases which roentgenologically presented the characteristics of diverticula, but in which the operative findings were those of a perforated ulcer. These 2 cases, however, were in the region of the pylorus and not in the upper end of the stomach.

Anatomically the junction of the esophagus and the cardiac end of the stomach is somewhat similar in structural characteristics to the junction of the pharynx and esophagus. There exists here an inherent weakness which is a point of predilection for the development of a diverticulum.

According to Keith[4] there exists here a "locus minoris resistentiae." It may be congenital, or it may be acquired and secondary to some defective factor in muscle arrangement. In some animals, as for example the pig, diverticula develop normally in connection with the cardiac end of the stomach.

The posterior wall of the esophagus and the stomach at the line of the cardio-esophageal junction being inherently weak, under certain conditions of increased intragastric pressure, there might be a traumatic separation of the fibers here, further aiding the formation of a pouch. Keith stated that he did not believe that diverticula here were congenital in origin. He followed a series of cases clinically and in several instances was able to obtain a past history

of a continued cough over a long period of time or a history of persistent vomiting over a long period and he believes that both of these conditions are true etiological factors, secondary or contributing in type.

Another theory of formation of these diverticula has been that a diverticulum in this region is secondary to a slow erosion of the lower esophageal wall with the formation of a secondary pocket or pouch but anatomical and histological examination of a fairly large series of sections of this area has failed to prove this.

Another point used in argument against the congenital origin theory is that if these diverticula are present from birth why do they wait until adult life to give symptoms?

The pathological anatomy in this condition has been described by many pathologists and there is a more or less unanimity in the recorded findings.

Zahn[5] described cases wherein there was a weakness or defect in the muscular wall of the stomach at or near the esophagus and the junction mucosa herniated through in either one or more places, causing several small pseudo-diverticula. He also called attention to diverticula secondary to foreign bodies in the stomach such as occur in mental cases. He described in detail the formation of a diverticulum secondary to a large hair-ball in the stomach in a case of hysteria.

He also first called attention to the occurrence of a diverticulum in association with pyloric stenosis and ulcer, and speculated as to whether the increased intragastric pressure secondary to the pyloric stenosis might not be the etiological factor in the production of the diverticulum.

This is an interesting fact because in two of the cases reported here there was a co-existent gastric or duodenal ulcer with pyloric obstruction.

One of the cases described by Zahn occurred in a woman with an hourglass stomach and a chronic stenosing ulcer of the pylorus in which on the greater curvature near the cardia there was a herniation of the mucosa through the muscularis to form a diverticulum. The wall of the diverticulum consisted of mucus membrane and the base was composed of hypertrophied muscle fibers.

He described another case in which the diverticulum was the size of a cherry, with very sharp borders but through which a finger could be inserted and the base was composed of a chronic indurated ulcer.

This in light of present day knowledge would undoubtedly be considered a case of penetrating ulcer and not a true diverticulum. In this case he described the mucus membrane of the mucosa as extending just to the edges of the diverticulum ring, and from here thinned out so that at the base there was only muscularis tissue with occasional small islands of submucosa.

He also called attention to the anatomical difference between true and false diverticula and to the occurrence of traction and pulsion diverticula in this region. In a case where there was a diverticulum in the fundus of the stomach just below the cardio-esophageal junction and which communicated with the stomach through an opening about one inch in diameter, the diverticulum itself being the size of a plum, he noted that it was covered completely by an intact serosa and that the entire mucous membrane lining was intact, but arranged in a series of stellate folds and that the muscularis was normal. This he attributed to the pull of perigastric adhesions following some perigastric inflammation and called it a traction diverticulum.

Rokitansky in 1840 first called attention to the fact that one of the etiological factors in the production of diverticula in this region might be sought for from without the stomach itself, that is, from surrounding or nearby inflammatory reaction which in process of healing contracts and draws adjacent structural membranes to it. A diverticulum formed in this manner he called a traction diverticulum and he described it as being cone shaped with the peak directed outward and the base toward the lumen of the stomach. In these cases

he stated that there is no tendency to the formation of a constricting neck with subsequent retention of food.

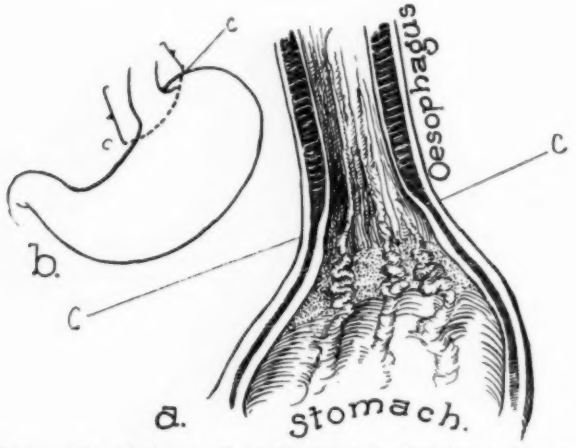

FIG. 1. Muscle layer of esophagus thinning down almost to a point at *c*, then continuing into stomach as a thin band with gradually increasing thickness. Line *c* in smaller drawing represents circular circumference at junction of cardia and esophagus where greatest point of weakness exists due to marked muscular thinning here. Keith's "locus minoris resistentiae."

The usual type seen is round or oval in shape, located in close proximity to the cardio-esophageal junction, probably caused by an increased pressure from within the stomach acting upon a local weakness or defect in the muscular layer at the line of junction of the esophagus and stomach, which may or may not be congenitally defective.

Due to the fact that the region of the cardio-esophageal junction is that most involved in these cases it is perhaps well to recall the anatomy of this locale.

Normally the longitudinal muscular fibers of the stomach divide at the dorsal wall of the cardiac region in two directions. One group of these branching fibers spreads over the fundus of the stomach and goes to the greater curvature, the other group follows the lesser curvature. The circular fibers which are very thick and abundant in the pyloric region of the stomach spread out more and are thinner as the cardia is approached.

The anatomical drawings (Figs. 1–5) illustrate this muscular arrangement more clearly.

The oblique fibers are likewise very thin at the cardia. In addition to this muscle-structure weakness there is an additional

FIG. 2. Esophageal muscle ending in a pointed cone-shaped formation, A, with definite intervening space of tissue only containing no muscle fibers before fibers of gastric musculature begin.

weakness in that there is a great and abundant blood supply in this area and many large blood vessels penetrate the gastric wall here, creating an even lesser intactness of the wall. (Fig. 6.)

Microscopically the arrangement of the muscular fibers is illustrated by Figures 7 and 8. These sections were selected from a large number cut at the approximate junction and have been cut diagonally from esophagus downward and illustrate the relative thickness of the muscle fibers above and at the junction as evidenced by

the ending of the stratified squamous epithelium lining of the esophagus and the beginning of the mucosa of the stomach.

that these are hernias, but their anatomical characteristics are against this. Their association with conditions in which there

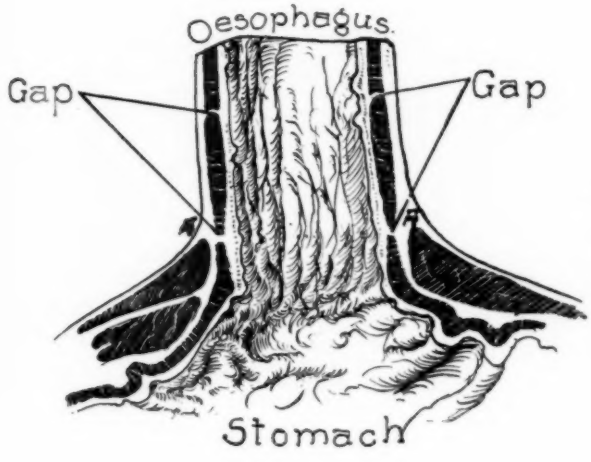

Fig. 3.

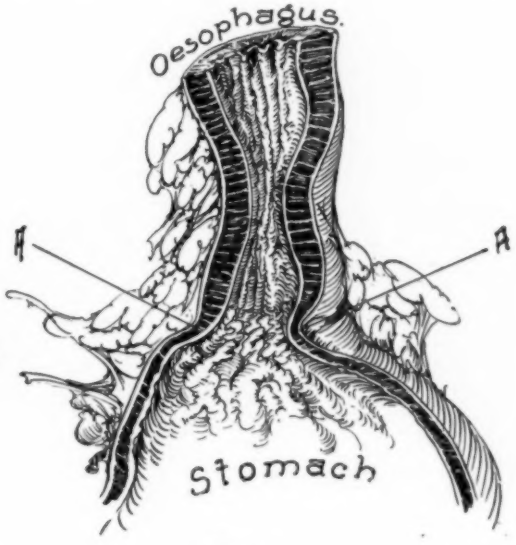

Fig. 4.

Fig. 3. Another type of muscular arrangement sectional in character with a definite gap between muscle bundles and a distinct gap at A.

Fig. 4. Another arrangement of musculature. There is no segmentation nor conization, but a distinct thinning down of fibers at point A.

Because the factors entering into the mechanics of these diverticula are similar to those present in the formation of a

is increased intragastric pressure, however, is borne out in the series of cases reported here in which 3 cases had pyloric obstruc-

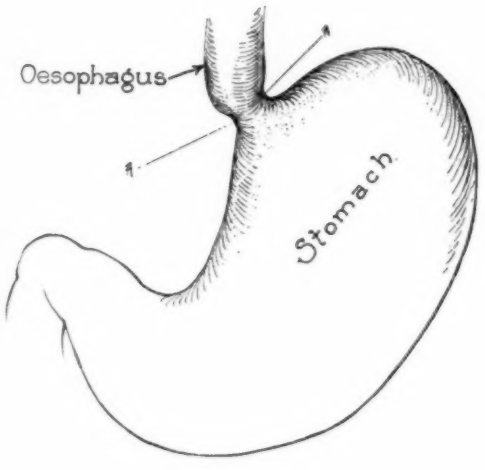

Fig. 5.

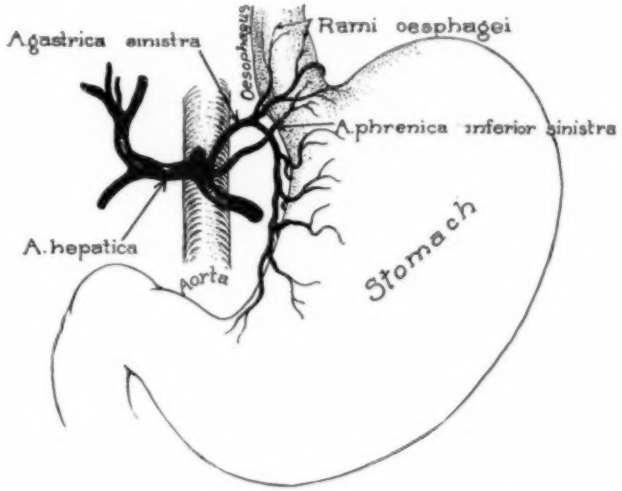

Fig. 6.

Fig. 5. Gross specimen of esophagus and stomach illustrating at points A that circular area at junction of cardia and esophagus where marked thinning of musculature takes place.

Fig. 6. Abundant blood supply in region of cardio-esophageal junction.

hernia, namely (a) an inherently weak or defective muscle wall, and (b) increased intragastric pressure, it has been stated

tion, and 2 cases gave a history of severe pertussis, with protracted, severe, spasmodic cough.

The traction type with their mechanics of formation as described by Rokitansky are usually found as secondary to one of

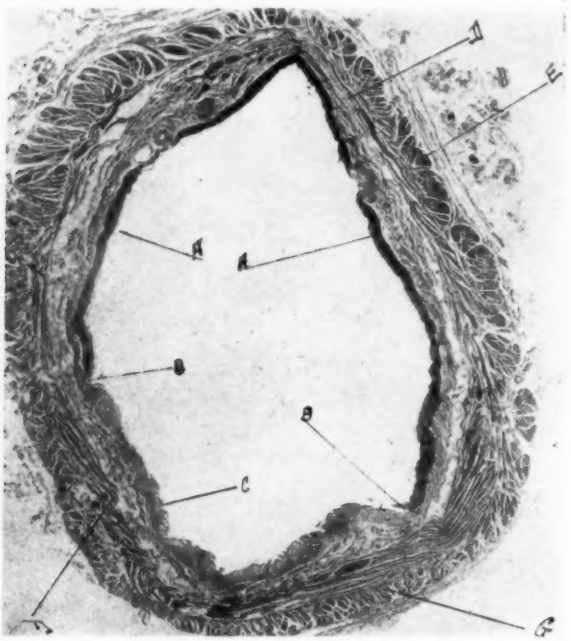

Fig. 7. Section taken at approximately junction of cardia and esophagus. (*a*) Stratified squamous epithelium of esophageal lining. (*b*) Point at which stratified squamous epithelium ends and gastric mucosa begins. (*c*) Gastric mucosa. (*d*) Circular muscle of esophagus. (*e*) Longitudinal muscle of esophagus. (*f*) Circular muscle of stomach. (*g*) Longitudinal muscle of stomach. Note definite diminution in amount of muscular tissue in this area.

the following:

(a) Inflammation in or about the gall bladder.
(b) Inflammation in the pancreas.
(c) Extragastric tumors.
(d) Adhesions between the abdomianl wall and the anterior wall of the stomach.

A case wherein the latter occurred was described by Chutro.[6] Following a cholecystectomy and appendectomy there was a localized peritonitis which when healed left an adhesion between the serosa of the anterior wall of the stomach and the peritoneum of the abdominal wall immediately adjacent, with the result that when the intra-abdominal pressure was increased part of the stomach wall was drawn into this hernial sac.

The microscopic pathology of the lesion is more or less constant. Usually the walls of the diverticulum are found to consist of a layer of mucous membrane showing a

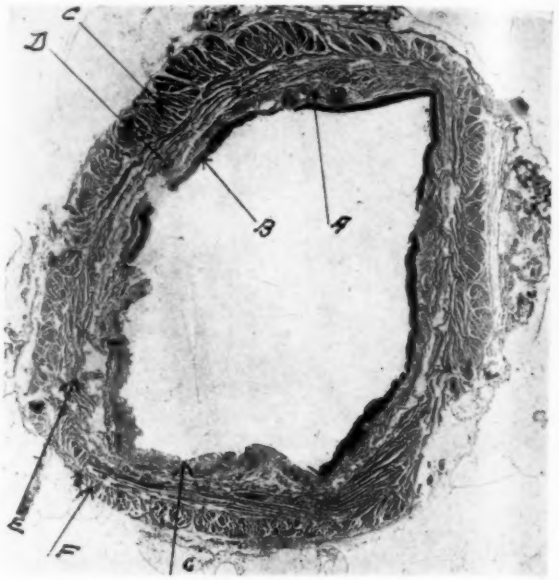

Fig. 8. Esophageal glands. (*b*) Esophageal lining stratified squamous epithelium. (*c*) Longitudinal muscle layer. (*d*) Circular muscle layer. (*e*) Circular muscle layer of stomach. (*f*) Longitudinal muscle layer of stomach. (*g*) Gastric mucosa.

varying degree of atrophy, then a very thin or incomplete layer of muscularis tissue with a varying degree of separation of the fibers, then an outer layer of peritoneum. Generally there is no evidence of any inflammatory change. True diverticula may be distinguished from false in that all the layers of the stomach wall are present, even though in some cases the muscularis layer is so thin that it must be searched for carefully. In the false type of diverticulum there is no layer of muscularis because the false diverticulum represents the herniation of the mucosa through and beyond the muscularis because of weakness or defect in that layer.

I have often felt that there might possibly be a lesion of Auerbach's plexus associated with these conditions and that secondary to this lesion a local atrophy with lowering of tissue tone might take place, thereby producing the locus minoris resistentiae, one of the necessary predisposing factors. I have never been able to prove this, however, in spite of several

attempts. However, Hurst,[7] of London, in a recent article describing a lesion in this area in which the mechanical factors in being found in the base of these diverticula. The question naturally arises as to whether or not these were diverticula or penetrating

Fig. 9. Section of normal ganglion of Auerbach's plexus in lower end of esophagus.

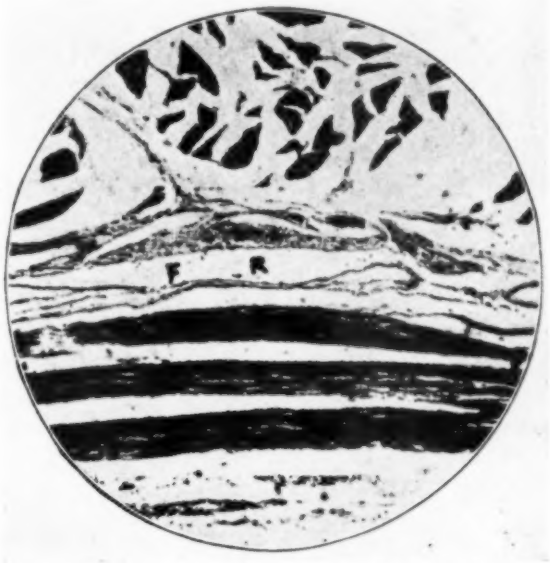

Fig. 10. Section through cardiac end of esophagus of patient with achalasia, showing (R) round-cell infiltration, and (F) fibrosis, of Auerbach's plexus, with complete disappearance of ganglion cells, none being seen in any of 250 serial sections.

production are about the same, showed photomicrographs in which he was able to demonstrate a lesion in the plexus. With his kind permission I have reproduced the photomicrographs here, with a description of the microscopical changes. Figure 9 demonstrates the microscopic picture of a normal Auerbach's plexus. Figure 10 demonstrates the changes which take place with lesions of the lower esophagus, particularly round-cell infiltration, disappearance of ganglion cells, and fibrosis.

Fleischner,[8] of Vienna, has described 2 cases in which the diagnosis was made roentgenologically and which later came to post-mortem examination. In one case the diverticulum wall consisted of mucous membrane and peritoneum with no evidence of any muscularis tissue whatever, probably a false diverticulum. In the second case all three layers were present, a mucosa, a sub-layer of muscular fibers, which were considerably atrophied, and then a layer of peritoneum. This is the true picture of a true diverticulum.

In earlier literature cases were reported in which large ulcers were described as ulcers.

Charles H. Mayo[9] has described a case in which there was a myoma in the diverticulum wall which was the cause of severe bleeding.

Some cases have also been reported in which aberrant pancreatic tissue has been found in the diverticulum sac.

Clinically it is of importance to determine various factors in these cases in order that proper therapeutic recommendations may be made. It is necessary to know whether the diverticulum opens widely and readily into the gastric lumen, allowing for easy ingress and egress. It is obvious that if there is a constricting neck or any mechanical obstacle which interferes with the ready emptying of the sac the future course of procedure for that patient is different than in that case where there exists a large and very wide opening so that emptying of the sac contents is an easy matter. Another point to determine is whether partial retention of sac contents takes place because of shape or position

of the diverticulum. Another and a most important factor is to determine whether there is active inflammation present in the diverticulum sac. Inflammation of the sac might be caused from retention of food particles, retention of free hydrochloric acid in the sac with subsequent concentration, or to mechanical trauma due to food fibers or food roughage.

As mentioned previously in those cases that have come to autopsy no evidence of inflammation has been found.

The possibility of the presence of an ulcer in the diverticulum is not to be overlooked and also the possibility of chronic irritation leading to malignant change in the walls of the diverticulum.

This possibility is not so great, as to date only 2 cases have been reported here in America where carcinoma was found associated with true diverticulum, one by Mayo[9] in 1910, and the other by Mellon[10] in 1921.

CLINICAL SYMPTOMS

Symptoms are usually due to retention of contents in the sac itself, to pressure on surrounding structures by a filled sac or to secondary irritation or inflammation in the sac. They are usually variable and indefinite. Epigastric discomfort of varied description, but which can oftentimes be divided into two types or varieties of symptoms, is also noted.

1. *Sub-sternal Symptoms:*
   a. Sub-sternal pain or pressure; a sensation of burning under the sternum. This may be due to either irritation of the walls of the diverticulum by retained contents, or by excess secretion of its walls secondary to irritation.
   b. Epigastric fullness usually described as delayed digestion of food or that the previous meal had not been completely digested.
   c. Precordial distress, or a feeling of pressure under the heart, causing palpitation of the heart, tachycardia and hyperesthesia of the precordium.
2. *Ulcer Symptoms:*
   a. Periodic pain, occurring soon after eating, epigastric burning, sometimes relieved by alkalies, acid food eructations, belching of gas, etc.

Åkerlund[11] has reported 6 cases. All were in women and in all of his cases the symptoms were those of ulcer.

The possibility of the simultaneous existence of a diverticulum at the cardia and an ulcer at the pylorus or duodenum, giving rise to ulcer symptoms, must be borne in mind.

ROENTGEN ASPECTS

Considerable information can be elicited in these cases by a careful roentgen examination. It is important to determine:

a. Site of the diverticulum.
b. Characteristics of its outline, whether smooth and even, or rough and irregular.
c. Uniformity of its shape.
d. Whether freely movable, or rigidly adherent.
e. Focal tenderness over area.
f. Size of diverticulum.
g. Presence or absence of constricting neck.
h. Amount of retention.
i. Ease of emptying.

It is sometimes necessary to use thick and thin barium meals and to place the patient in more or less unusual positions in order to get the barium into all parts of the diverticulum. The Trendelenburg position and having the patient lie on the right side has been found the easiest method of filling the diverticulum pocket in some of the cases reported here. Attempts to incline the body to the right and then to the left while drinking a glass of water, theoretically washing out the pocket have not been tried, as it is believed they would serve no practical purpose.

Films taken twelve to twenty-four hours after the ingestion of the barium are,

however, important as they indicate to some degree the amount of retention.

The characteristic finding is a sharply defined, smoothly outlined shadow of varying size, extending out from the lumen of the stomach and connected to it by a narrow neck. The pocket frequently retains barium after the stomach is empty and in the upright position sometimes a fluid level can be made out.

Kalbfleisch[12] gives tersely and briefly a description of the usual roentgen findings, as follows:

> It appears as a persistent, smoothly outlined, rounded, movable, insensitive pocket with no infiltration, no retraction and no spasm opposite to it, usually situated on the posterior wall of the cardia of the stomach and presenting a gas bubble with a fluid level when examined with the patient in the upright position.

DIFFERENTIAL DIAGNOSIS

Usually this is not difficult; one must, however, differentiate two conditions:

(a) A gastric ulcer on the lesser curvature of the stomach penetrating into the gastrohepatic omentum. Figure 11 illustrates this particular condition. It will be noted that the outline is not smooth, that the shape is irregular and that the characteristics are those of a penetrating ulcer. Figure 12 represents this same case after one month on a medical ulcer regime with complete disappearance of the lesion, definitely ruling out diverticulum.

(b) (Fig. 13.) Oftentimes a Haudek's niche will simulate a diverticulum but a close scrutiny of the lesion characteristics suffices to make the differential diagnosis. Pictures taken later will not show the same characteristics as in the first pictures, if the patient has been on an adequate medical regime. The illustrations here represent a Haudek's niche high up on the lesser curvature which is more conical in shape with the apex outward and although it has no similarity to a true diverticulum could be misconstrued as a traction type. However, there was complete disappearance of this niche after one month of medical ulcer regime.

(c) Herniation of the small portion of

Fig. 11.

the cardia of the stomach through the hiatus oesophagei could closely resemble a diverticulum. However, all of the cases of this condition which I have seen clinically have been much larger than one would expect in a diverticulum, involving usually a considerable portion of the cardia, and it was not difficult to differentiate roentgenologically.

TREATMENT

Jordan and Lahey[13] state that surgical treatment of diverticula near the cardiac orifice of the stomach and situated on the lesser curvature as they usually are, is impractical and usually impossible because of the difficulty in mobilizing the stomach and dissecting the sac. The technical difficulties of esophagogastric anastomosis outweigh the possible advantages of sac removal in the largest percentage of cases. Surgical intervention was advised in only

one of the cases in this series and then only because the sac was extremely large, probably inflamed and with marked retention of contents (Fig. 18). In this particular case surgery was refused and the patient has progressed reasonably well with daily symptoms to which he has more or less adapted himself. In the smaller diverticula the difficulty in detecting the opening into the stomach is not to be minimized, as in a diverticulum which has a small slit as the stomach opening and with the mucosa thrown up into folds, the identification and localization of the opening is no easy task. In view of the fact that carcinoma has been reported as occurring in such a small percentage of cases it seems scarcely justifiable to expose patients to this surgical risk.

Fig. 12.

Postural drainage in the large diverticulum seems of very doubtful value. It was tried in one of the cases in this series with no beneficial effects whatever.

CLINICAL REPORTS

Case 1. (Fig. 14.) Mrs. W. P., aged fifty-seven, widow, housewife.

Complaint: A heaviness and feeling of weight in epigastrium accompanied by bloating of abdomen, occurring almost immediately after eating. Constant soreness in upper abdomen, aggravated by any motion such as bending, etc., described as a pressure, and relieved by holding her abdomen. No pain, no difficulty in swallowing, no vomiting, no belching of gas, bowels have been moving regularly, no black or tarry stools, has never passed any blood per rectum. Never any hemoptysis or hematemesis. She has noted that her symptoms are much aggravated when she is either worried, excited, or under any nervous tension or strain. Has noticed that carbohydrate foods, starches seem to increase her symptoms so that for some time she has been on a very low carbohydrate diet.

Fig. 13.

Past History: These symptoms have been present in a varying degree for the past four years but have been more intense in the past two months.

Physical Examination: Poorly developed, fairly nourished, female, weight 108 lbs. which is her usual weight, no recent gain or loss.

Teeth: Hygiene poor, marked pyorrhea, several suspicious crowns and several fillings. *X*-rays of teeth showed apical abscesses in the upper right second bicuspid and first molar, lower left first and second molars, upper left first molar.

Throat: Tonsils enlarged, cryptic and pure pus can be expressed from each tonsil.

Lungs and Heart. Negative.

Fig. 14.

Fig. 15.

Fig. 14. Small diverticulum just at junction and more posteriorly and a second larger diverticulum just above junction more anteriorly.

Fig. 15. Small diverticulum situated anteriorly just at junction of cardia and esophagus.

Abdomen: Marked tenderness on palpation in entire upper abdomen; there is some spasm and rigidity of the musculature over the same area; tenderness is general, not sharply localized over any particular area; lower abdomen is negative. No masses felt. Liver and spleen not felt.

Reflexes: Normal.

Laboratory: Urinalysis: specific gravity 1,003, acid; albumin negative; sugar negative. Blood: hemoglobin 72 per cent; differential count normal; Wassermann-reaction negative. Gastric Analysis: On two occasions was attempted, when without any trauma or mechanical difficulty in passing tube specimens contained so much bright red blood that tube was removed each time without further attempt to obtain gastric contents. Stool: Three specimens, each positive for occult blood.

Roentgenographic: Cholecystography: normal functioning gall bladder; no evidence of stone. At the junction of the cardia portion of the stomach and esophagus there are two small diverticula about the size of a small marble, one of which is situated just at the junction and more posteriorly and the second and larger one situated just above the junction and more anteriorly. Gastrointestinal series: (a) pyloro-spasm marked; (b) duodenal ulcer; (c) partial stenosis of duodenum.

Treatment consisted of giving the patient: (a) antispasmodic: atropine in large dosage before each meal; (b) strict ulcer diet; (c) alkalinization.

The ulcer apparently healed after three months of treatment, and the patient became symptom free. Roentgenographic examination showed the diverticula still present and of the same physical characteristics as previous examination.

Case II. (Fig. 15.) Male, aged sixty, elevator operator.

Complaint: Dates his onset of symptoms to one year ago, when because of economic conditions he was forced to find some occupation. Previous to that time had always been in good health. He states that the change from his sedentary life to his occupation which required considerable rushing about with only a half hour for meals, three times daily, brought on at first distress after meals, consisting of bloating, belching of gas, eructation of sour material and marked constipation, which necessitated

his taking either compound licorice powder or cascara sagrada three times weekly. After about three months of such symptoms he began to have a definitely localized mid-epigastric pain, described as gnawing in character, occurring almost constantly two and one-half hours after eating and relieved either by taking more food, such as a glass of milk, or by taking soda bicarbonate. Pain usually comes on also at 1 A.M., severe, but relieved when he takes a glass of warm milk. The bloating, belching of gas, etc., have continued throughout and the constipation has persisted. No hematemesis or hempotysis. No blood in stools to his knowledge, no black or tarry stools.

Laboratory: Urinalysis: negative. Blood: Wassermann reaction negative; R.B.C., 7400; hemoglobin 78 per cent; differential count normal.

Gastric Analysis:

	Fasting	15 min.	30 min.	1 hr.	2 hrs.
Free HCl.....	12	12	28	46	68
Comb. acid.....	20	26	22	28	26
Total acid.....	32	38	50	74	94

Stool examinations: Three specimens negative for occult blood.

Roentgenographic: Gall-bladder visualization, normal functioning gall bladder.

Gastrointestinal series: There is a regularly outlined shallow niche just at the pylorus about 2.5 cm. in width on the lesser curvature of the stomach and extending about 1 cm. over into the duodenum along the superior border. The duodenal bulb is irregular in outline, somewhat spastic, does not fill readily and empties rather slowly and incompletely. At the upper end of the stomach, at the gastro-esophageal junction there is a small, smoothly outlined pouch about the size of a marble, situated anteriorly, which fills readily with barium and is easily outlined.

Treatment: This patient was put upon a strict medical ulcer regime and became free of pain and gastric distress, gained 30 lbs. in four months, but has always had his sense of fullness and incomplete digestion after meals.

Re-examination by *x*-ray on two later occasions have shown no change in size or shape of the diverticulum sac. It was possible to demonstrate that the neck or avenue of ingress and egress was of sufficient calibre that stasis of barium in the sac was not constant, but readily emptied in about one half hour.

CASE III. Miss M., aged twenty-four, single.

Complaint: Left upper quadrant abdominal pain, described as boring in character, sharply localized, does not radiate, present intermittently for past two years, with varying periods of freedom from symptoms. Pain has no relation to food intake and is not relieved or aggravated by taking food. Began about two years ago, usually lasts about a week or ten days then disappears gradually to recur in three to four weeks. No vomiting, some eructation of acid, considerable belching of gas, bowels move normally and regularly without aid of cathartics.

Past History: Negative except that six years previously Wassermann test was positive and she received treatment over a period of one year; Wassermann reaction has been negative since then.

Physical Examination: Entirely negative except for sharply localized tenderness on palpation in the left upper quadrant in about its mid-portion.

Roentgenographic: Complete gastrointestinal studies negative except for a minute diverticulum extending outward from the lesser curvature of the stomach at a point about one-third the distance from the cardio-esophageal junction to the pylorus. This case has been lost track of and subsequent examination has not been made.

CASE IV. (Fig. 17.) Male, aged forty-four years, electrician.

Complaint: A feeling of fullness and distention in epigastrium after eating accompanied by a sense of pressure over his heart, fluttering and palpitation and moderate dyspnea. No nausea or vomiting, but occasionally spits up small amounts of undigested food. The feeling of pressure over his heart has made him "heart conscious" and he is constantly taking his pulse and states that he has noticed on occasions some skipping of beats.

Past History: Symptoms began three years ago following an attack of whooping cough which was unusually severe and lasted about ten months, the cough being hard, dry, and the paroxysms particularly prolonged and severe.

Physical Examination: Entirely negative, including laboratory findings. Electrocardiographic study of the heart showed a normal heart.

Roentgenographic: Complete gastrointestinal study negative except at the lowest portion of the esophagus just above the diaphragm there is a small diverticulum on the posterior aspect about the size of a marble.

Fig. 16.

Fig. 17.

Fig. 16. Extremely minute diverticulum at cardio-esophageal junction, but some distance away on lesser curvature of stomach.

Fig. 17. Small diverticulum just above cardio-esophageal junction on posterior aspect.

Treatment in this case consisted of belladonna and bromides over a prolonged period plus a smooth, bland diet with small amounts of food at more frequent intervals. Symptoms were markedly benefited under treatment.

Case v. (Fig. 18.) Male, aged forty, Italian, laborer.

Complaint: Sub-sternal pain described as constant, boring in character, radiating to back, accompanied by a sense of fullness and distention in abdomen after eating. No vomiting, no hematemesis, bowels function normally. No blood in bowel movements. No black or tarry stools.

Past History: One year previously was operated upon for a malignant hemangio-epithelioma of the left maxillary antrum and he dates his symptoms from this time.

Physical Examination: Entirely negative. There had been no loss in weight in past six months.

Laboratory: Stools negative for occult blood on several examinations. Gastric Analysis: no blood and normal acid values.

Gastrointestinal X-ray: The lower third of the esophagus was dilated and irregular in outline. At the junction of the esophagus and cardia on the anterior aspect there was a wide mouthed diverticulum about the size of a walnut which filled readily and emptied easily. It was somewhat irregular in outline and the physical characteristics were such that malignancy was suspected. Opportunity for re-examination of the patient was not available and his subsequent progress is unknown.

The case is presented merely to show the size and shape of the diverticulum and the possible association with malignancy.

Esophagoscopy: Showed a normal appearing mucous membrane in this area and no evidence of malignancy.

Treatment of this case consisted of belladonna after meals and dietary control, frequent small feedings of smooth, bland types of food.

Case vi. (Fig. 19.) Male, aged seventy-six, no occupation.

Complaint: Epigastric pain, usually directly after eating, not severe, not relieved by sodium bicarbonate or alkali and described as

a dull, gnawing pain. No nausea. Frequently vomits particles of food, usually undigested, never any blood in vomitus. Bowels function regularly without use of laxatives. No gas distention. No tarry stools or blood in stools. Notes that meat makes pain worse.

Past History: Does not remember childhood illnesses; had not been ill in adult life. Teeth were extracted ten years previously because of caries and pyorrhea. His present symptoms began about five years previously when he noted that about once a week he had a vomiting spell which would last about twenty-four hours and would be accompanied by epigastric pain.

Physical Examination: Except for anterior sclerotic changes negative.

Laboratory: Gastric analysis showed from four to eight degrees free hydrochloric acid over a two-hour period and a total acidity of from 10 to 50 degrees in the same interval.

Roentgenographic: At the junction of the oesophagus and cardia on the anterior aspect there was a diverticulum about the size of a walnut, which filled and emptied readily; the remainder of the gastrointestinal tract was negative.

Electrocardiographic studies were made of the heart and showed it to be normal.

Esophagoscopy: Tremendous difficulty was encountered in passing the esophagoscope due to inability on the part of the patient to cooperate, so was abandoned.

Fig. 18.

Fig. 19.

Fig. 18. Diverticulum size of walnut, irregular in outline, physical characteristics such that malignancy was suspected.

Fig. 19. Diverticulum about size of walnut, situated anteriorly at junction of esophagus and cardia.

Treatment in this case consisted of atropine and bromides also, with a smooth, bland diet over a prolonged period with considerable amelioration of symptoms. One year later examination of this patient showed exactly the same roentgenographic findings.

Case VII. (Fig. 20.) Female, widow, aged fifty-two years.

Complaint: Pain in upper left quadrant of abdomen for past two years. Appears usually immediately after eating, lasts about an hour, then gradually subsides, but never seems to disappear entirely, constantly a dull soreness in same region. Occurring with the pain there is usually a sense of precordial pressure, anginoid in type and a feeling of numbness extending from her left shoulder to the tips of the fingers of the left hand. Except for occasional acid eructations no other gastric symptoms such as nausea or vomiting. Bowel function is poor and she usually takes laxatives twice to three times weekly. The precordial distress is usually worse after the evening meal, frequently keeping her awake at night. She

finds that the sense of precordial pressure can sometimes be relieved by using several pillows at night. On several occasions she has awakened

Fig. 20. Diverticulum about size of marble just at cardio-esophageal junction, anterior aspect.

with a smothering sensation and has had to jump out of bed quickly and struggle for air. Patient is nervous and apprehensive; has had many family difficulties and knows that her symptoms are much worse when she is worried.

Physical Examination: Entirely negative.

Electrocardiographic studies were made of the heart and showed it to be normal.

Roentgenographic: Showed a small diverticulum about the size of a marble just at the cardio-esophageal junction; the remainder of the gastrointestinal tract was negative.

Esophagoscopy: Tremendous difficulty was encountered in passing the esophagoscope due to inability on the part of the patient to cooperate, so was abandoned.

Treatment: Consisted also of atropine and bromides, with a prolonged period with considerable amelioration of symptoms.

Case viii. (Fig. 21.) Male, aged forty-four years, salesman.

Complaint: Epigastric distress, consisting of distention, belching of gas and regurgitation after eating; no nausea or vomiting; no pain. Frequent headaches and attacks of vertigo but seem to be associated with his gastric symptoms. Symptoms have been present intermittently for the past five years with varying periods of complete freedom from symp-

Fig. 21. (*a*) Diverticulum of esophagus situated just above level of cardio-esophageal junction about size of hazel nut. (*b*) Another diverticulum in third portion of duodenum, slightly larger in size.

toms during this time.

Past History: Negative except for a four plus Wassermann reaction about ten years ago, which he was treated for and subsequent Wassermann tests have been negative.

Physical Examination: Physical examination was entirely negative.

Laboratory: Blood and spinal fluid, Wassermann tests were negative.

Roentgenographic: Showed a diverticulum of the esophagus situated anteriorly at just above the level of the diaphragm about the size of a hazel nut; also another diverticulum in the third portion of the duodenum, slightly larger in size and a third diverticulum of about the same size in the splenic flexure of the colon.

Treatment: Consisted of the same regime as outlined in other cases in this series, with gradual diminution in symptoms temporarily at least.

CONCLUSION

1. That more careful scrutiny of the upper end of the stomach and particularly of the cardio-esophageal junction during fluoroscopic examination would show that the instances of diverticula in this area are more common than supposed. The

finding of these diverticula would help to explain the symptomatology in many cases in which the findings are said to be negative.

2. The association of a considerable number of these cases with ulcer and pylorospasm.

3. The possibility of obtaining a past history of a prolonged period of abnormally increased intragastric pressure such as in the 2 cases of pertussis in this series and in women a history of a prolonged period of pernicious vomiting of pregnancy.

4. That treatment should be medical rather than surgical, due to obvious technical operative difficulties.

5. That the differential diagnosis of true diverticulum is not difficult, penetrating ulcers having different outline characteristics as illustrated in two cases here.

6. That the possibility of ulcer within the lesion itself as in one case of this series, must be kept in mind.

7. That the occurrence of carcinoma in one of these diverticula although extremely improbable if based on past post-mortem experience should be kept in mind because of the irritative factors present.

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REMOVAL OF PLASTER-OF-PARIS CASTS

MADE EASY BY THE PRELIMINARY SOAKING IN WATER*

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THE removal of plaster-of-Paris casts requires some physical effort, depending on the thickness of the cast and its location; because of this, various types of instruments and methods have been tried to make this procedure less difficult and time consuming. Cast cutters, knives, saws, shears and spreaders are all used at some time or other but even with these, the cutting of a cast and its spreading still require much work. The formidable appearance of the instruments is somewhat terrifying to the patient because of the fear that the underlying soft tissues will be injured during the removal.

Some men still remove casts by cutting through them in the dry state; when the bottom of the cast is reached, the cast is spread with great difficulty, either manually or with the spreader; others use water dropped in the line through which the cast is cut. Other substances as hydrogen peroxide and acids as glacial acetic and hydrochloric are sometimes utilized to soften the cast material in the line through which the cut is made.

Shelling and Cohen[1] recommend the use of 25 per cent sodium or potassium citrate solution applied over the area through which the cast is to be cut; later Barnes[2] used 50 per cent solutions of the same substances and described an instrument with which the solution can be dropped continuously in the line through which the cut is being made. The citrate method softens the cast in the region to which it is applied so that cutting becomes easier than with some other methods but the matter of spreading still presents as much difficulty as before.

Mallot[3] places hollow tubes, such as soda straws, over the whole length of the part to which the cast is applied and through each straw, a string or thin wire is run, the ends of which are brought up to the surface of the finished cast; when the cast is to be removed, he ties a Gigli type saw to one end of each string and pulls it through the tube and saws the cast in sections from below up; the matter of spreading still presents the same difficulty as in any of the methods so far described.

Franke[4] described the removal of casts made easy by either immersing the part containing the cast in dilute salt solution or by applying a wet cloth soaked in it for fifteen or twenty minutes prior to its removal; the cast becomes generally softened and can be cut through easily with a pocket knife and spread rather readily.

I noticed that by immersing the cast plus the encased part in warm water for fifteen or twenty minutes or by allowing warm tap water to run over it or by wrapping the cast in a wet towel, thin casts soften readily and become quite pliable so that they may be easily removed either with an ordinary bandage scissors or with a pocket or cast knife. Spreading is simple because the whole cast is so pliable; heavier casts do not soften so readily and are not so easily compressed but they do cut readily with a knife and come off in layers which are easily spread by hand.

If, when the cast is put on, the end of each roll of plaster bandage is outlined with an indelible pencil, then when one wants to remove it, it is simple to find the end of each roll; after soaking in water the bandage may be unrolled and the cast removed without the use of any cutting instruments.

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RECURRENCES FOLLOWING INGUINAL HERNIOPLASTIES

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DEFINITION

THE term "recurrence" in reference to inguinal hernia, is really a misnomer. It is often used inadvisedly. An anatomical defect is said to recur only when the condition which was repaired returns in its preoperative state. If another pathological condition appears, then we cannot say that we have had a recurrence. To illustrate this point, if after an operation for appendicitis, a patient develops gall-bladder disease, we must consider that we have a new anatomico-clinical entity. Similarly, a postoperative incisional hernia after an appendicectomy is not a recurrence of the original condition.

Most of our so-called recurrences of inguinal herniae after hernioplasties are not true recurrences at all, but are postoperative incisional herniae of one form or another. Sometimes we are of the opinion that the patient has developed a new condition, i.e., a direct hernia, but this is in reality nothing more than an incisional defect as the result of an operative intervention.

RECURRENCE OF SAC

Let us now consider the return of a sac through the deep ring after a hernioplasty operation. What are the causes? There is, and can be, only one, namely, a failure to remove the entire sac. This failure is due to too low a ligation of the peritoneal pouch. It is very rare and almost impossible for a sac to return at the original site of protrusion after a high ligation. When this does occur, then there has been some contributory anatomical defect, such as a weak musculature, to account for it. Therefore a high ligation of a sac, irrespective of whether or not any further procedure is added, should be sufficient to prevent recurrences, other things being equal. (Figs. 1 and 2.) However, one should not expect to cure an indirect inguinal hernia where the musculature and aponeurotic structures are defective, simply by a high ligation of the sac. Similarly, a diastasis recti or an epigastric hernia will not be cured by plicating its peritoneal redundancy and nothing more. In a number of cases of large indirect inguinal herniae, a considerable amount of traction must be made on the sac to take up the slack in the parietal peritoneum. The stretched peritoneum is visible in a secondary protrusion through Hesselbach's triangle as the so-called pantaloon or saddle-back hernia or just a bulge in this region. (Figs. 3 A–C). In addition, the deep epigastric vessels are displaced medially and anteriorly (see Fig. 3B) by the large original sac. By pulling on the funicular process of peritoneum not only is the peritoneum in Hesselbach's triangle rendered taut, but similarly the overlying transversalis fascia.

Here a very important, though seldom appreciated, point in the human mechanism is noted. Just within the deep ring, the peritoneum is intimately adherent to the transversalis fascia by means of firm synechiae, except of course, where the cord and its contents lie between the transversalis fascia and peritoneum. Therefore, when one ligates the funicular processes of the peritoneum high enough, the surrounding transversalis fascia is tightened and approximated and so the deep ring is sufficiently narrowed. It is for this reason then, that it is unnecessary to narrow the deep ring by applying a suture lateral to

the emergence of the cord, especially when one is almost certain to include the ilio-inguinal and ilio-hypogastric nerves in the suture. (Fig. 4.)

If the slack in the peritoneum is not eliminated by a ligation of the sac that is high enough, we can readily see that when a sac returns it is due to faulty technique rather than a recurrence of the original hernia. (Fig. 2.)

For the past few years, with spinal anesthesia, the visualization of sacs has been made easier by having the patient cough during the operation. The writer has not used local anesthesia because of the danger of pressure necrosis, and the possible introduction of infection.

We have been taught to narrow the subcutaneous rings and even to place a suture through the periosteum of the pubis. These are, anatomically and mechanically, faulty procedures. In fact, strict observance of this form of technique has resulted in many cases of scrotal swelling due to compression of the pampiniform plexus with subsequent edema.

We often hear the statement made that an infection in a hernioplasty wound is bound to be followed by a recurrence. In a study of 50 cases of indirect inguinal hernia, complicated by postoperative wound infections, there has not been noted the return of one peritoneal sac. In two of these, a postoperative incisional hernia resulted which may or may not have been due to the infection. However, it is possible for a wound infection to lead to a postoperative hernia, but as a rule the peritoneum is resistant and holds. Infection, therefore, is not a cause of the return of a sac, but on the contrary, tightens tissue, as is sometimes evidenced by the testis being drawn up.

POSTOPERATIVE INCISIONAL HERNIA

These comprise 86 per cent of the 50 cases of recurrence in our series. Let us analyze the various factors of the causative agents. The first and most important is poor musculature. When one hesitates to advise operation in patients over fifty or in weak younger

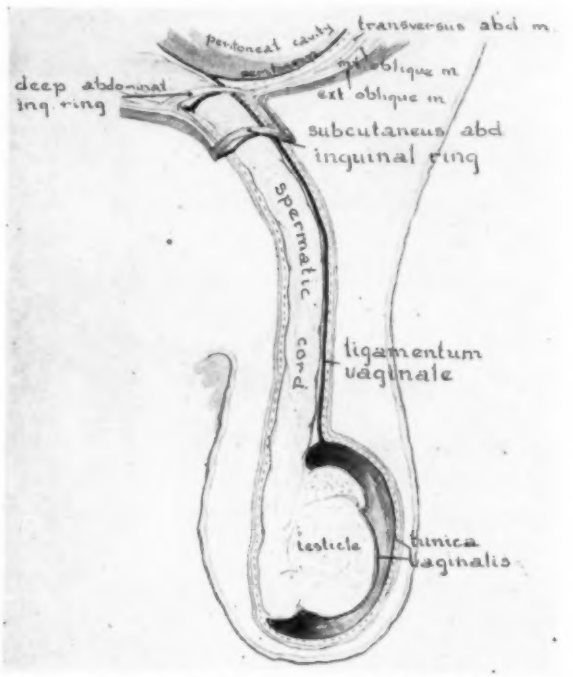

Fig. 1. Normal inguinal canal showing ligamentum vaginale.

individuals for indirect or oblique inguinal herniae it is because of the danger of a subsequent postoperative incisional hernia. The weak tissues cannot stand the operative insult and as a result, the new fibrous tissue stretches and yields readily. At re-operation one finds a large defect occupying the entire inguinal region. If there is a suggestion of a sac it is merely a part of what may be termed an inguinal prolapse. (Figs. 2 and 5.) Further intervention in these cases by the Gallie or MacArthur technique helps in about 10 per cent of the cases and then only when the patient is able to pursue a sedentary occupation. The advice is often given, to be careful in all hernioplasties to approximate the conjoined tendon to the shelving portion of the inguinal ligament. Most of us do this as a matter of habit, but the writer has little faith in its value in the repair of a hernia or in a prevention of either a recurrence or of a postoperative incisional hernia.

When a muscle is stitched to another muscle or an aponeurotic tissue, the agglutinating factor is mesodermic tissue

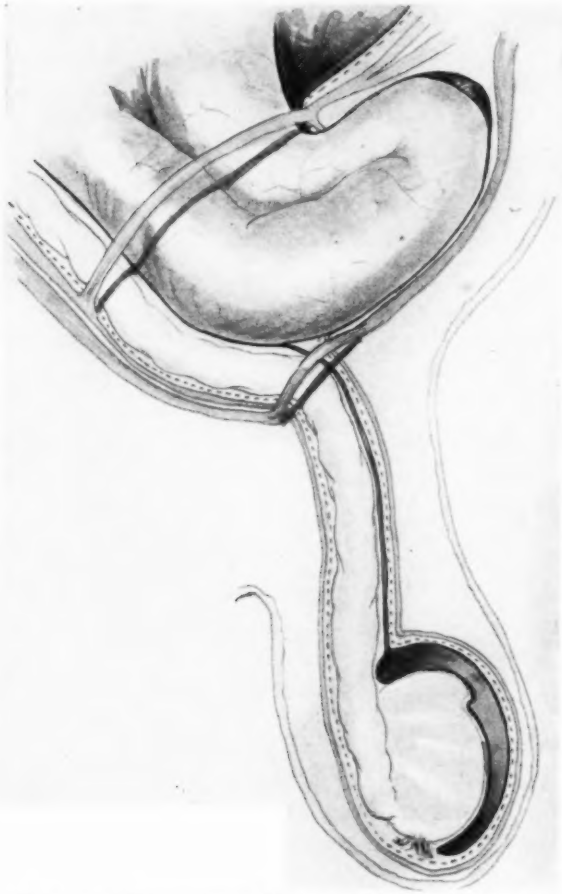

Fig. 2. A. Recurrence due to too low a ligation.

of the connective tissue variety. This connective tissue is from the perimysium or epimysium or replacement myofibrosis. In an individual whose musculature is weak, the proliferation of connective tissue in the muscles cannot act as a reinforcing factor; in fact such a state of affairs helps weaken what little powers the muscle had.

PARALYTIC TYPE

There is still another type of weakness due to a constriction or division of the ilio-inguinal and ilio-hypogastric nerves. (Fig. 4.) This condition results in weakness of the muscular boundary of the deep ring, the sphincter of the deep abdominal ring. A deep suture, if placed laterally to the deep abdominal ring, will almost certainly transfix these nerves and thus weaken the internal oblique and transversus abdominal muscles. According to McGregor the deep

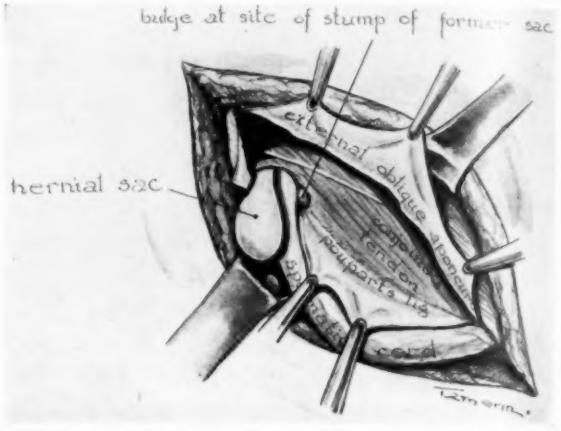

Fig. 2 B. Sac has not reformed at site of ligation.

ring with its sphincter is then permanently weakened by section of its motor nerve. As a result, at re-operation one notices in the type already described, the protrusion of the peritoneum lateral to the deep epigastric vessels. (Fig. 5.) These herniae are not a sacular type but are really a bulge, so to speak, of the parietal peritoneum, in the region of the deep ring. There is *no* evidence of a sac. The condition found at the primary operation has been cured, but due to the loss of sphincteric action, the parietal peritoneum and its supernatant transversalis fascia have nothing to support them or hold them in place. At the first operation a high sac ligation would have sufficed, but unfortunately the only physiological mechanical factor which would have prevented a recurrence has been removed, namely, the sphincter of the deep abdominal ring. (Fig. 5.)

TIME OF RECURRENCE

It is a well-known fact that when inguinal herniae return they do so as a rule within one month after operation. In fact, there is always some evidence of this condition even before the patient leaves the hospital. Often one takes the swelling for a postoperative edema but within a few weeks a definite hernia is found. It is inconceivable that a sac can

reform in so short a time; but an incisional hernia in the inguinal region can and does form very rapidly. All indirect inguinal hernias are in reality congenital. A preformed sac exists, perhaps let us say a poorly agglutinated funicular process just awaiting the proper strain to re-establish the lumen which existed in utero. If there is such a condition as a hernia forming later in life then the time element must be long. Repeated insults must ensue. A completely closed funicular process, or in other words, a real ligamentum vaginale will not reopen, nor will a ligated sac which is equivalent to an obliterated funicular process, reform.

Fig. 3. A. Bulge in Hesselbach's triangle.

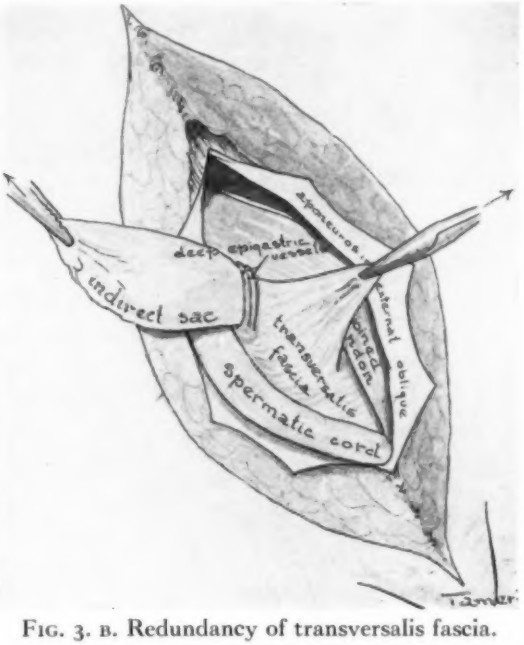

Fig. 3. B. Redundancy of transversalis fascia.

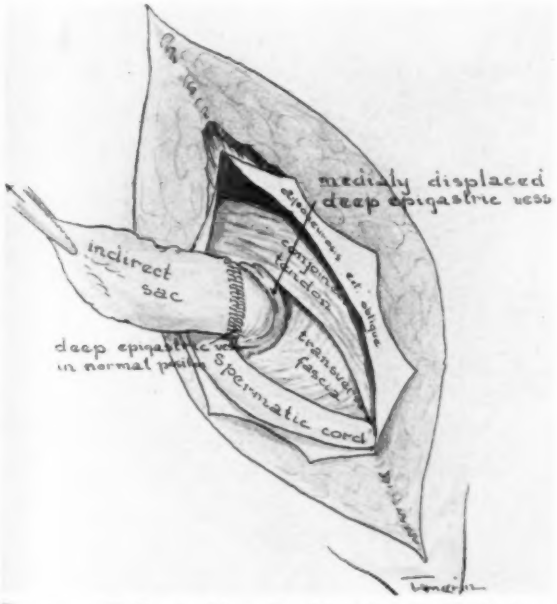

Fig. 3. C. Bulge in Hesselbach's triangle displacing vessels.

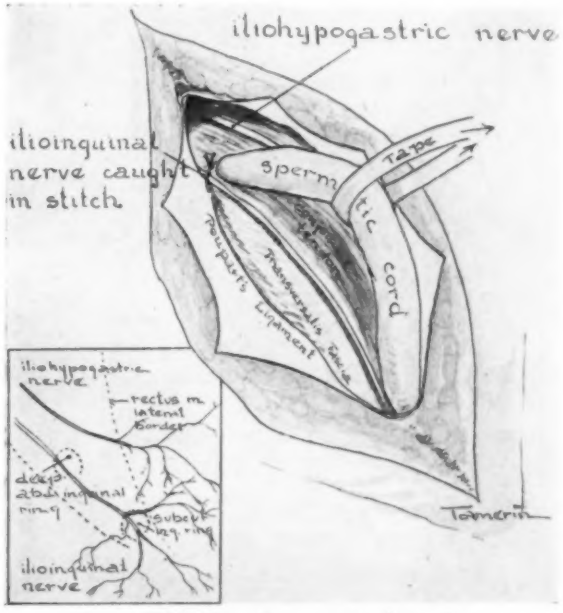

Fig. 4. Relation of nerves to deep ring.

CLASSIFICATION

Watson states in his admirable work on hernia that recurrences may take place in one of three places. Namely, through

TABLE 1

Case No.	Age	Sex	Age at 1st Operation	Original Diagnosis	Operative Procedure and Date	Time of So-called Recurrence	Type of Recurrence	Procedure	1 Yr. Later Recurrence and Date
1	42	M	37	Right indirect inguinal	1928 Bassini	Three weeks later	Lateral to deep ring. Bulge. No sac. Type 2	1931 Willys Andrews	No
2	47	M	43	Right indirect inguinal scrotal	1929 Willys Andrews	Six months later	Incisional along canal. Type 3	1931 Modified Willys Andrews	No
3	37	M	32	Left indirect inguinal	1928 Bassini	Three weeks later	Lateral to deep ring. Bulge. No sac. Type 2	1931 Modified Willys Andrews	No
4	55	M	52	Right saddle-back hernia	1930 Willys Andrews	Two weeks later	Incisional along canal. Type 3	1932 Willys Andrews. Fascial suture from thigh	Yes One year later
5	60	M	57	Strangulated right scrotal hernia	1930 Willys Andrews	2½ weeks later. Wound infection	Incisional along canal. Type 3	1931 Willys Andrews fascial & orchidectomy	Yes Two months later
6	37	M	32	Left indirect inguinal hernia	1928 Bassini repair	Ten days later. Wound infection	Bulge through Hesselbach's triangle. Type 4	1929 Willys Andrews	No
7	62	M	56	Left saddle-back hernia	1927 Willys Andrews	Three months later	Incisional along canal. Type 3	1920 Willys Andrews fascial repair	Yes Three months later
8	39	M	33	Left indirect inguinal. Poor abdominal wall	1927 Willys Andrews	Two weeks later	Bulge through Hesselbach's triangle. Type 4	1929 Willys Andrews	No
9	43	M	38	Right indirect inguinal	1928 Bassini	One year later. Laborer	Lateral to deep ring. Type 2	1930 Willys Andrews	No
10	37	M	32	Right indirect inguinal	1927 Bassini	Three weeks later	Indirect inguinal. Type 1	1931 Willys Andrews	No
11	57	M	53	Right saddle-back hernia	1929 Willys Andrews	Three weeks later	Incisional along canal. Type 3	Willys Andrews with fascial suture	Yes Two months later
12	29	M	25	Left indirect inguinal	1929 Bassini	Two weeks later	Left indirect inguinal. Type 1	1932 Bassini	No
13	35	M	33	Left indirect inguino scrotal hernia. Obese	1931 Willys Andrews	Three weeks later	Lateral to deep ring. Type 2	1932 Willys Andrews fascial suture	Yes Two months later
14	46	M	42	Bilateral indirect inguinal	1929 Bilateral Bassini	Two weeks later Left side	Lateral to deep ring. Type 2	1930 Willys Andrews	No
15	50	M	48	Indirect inguinal (left)	1931 Bassini	2½ weeks later	Lateral to deep ring. Type 2	1932 Willys Andrews	No
16	57	M	56	Left saddle-back hernia	1930 Willys Andrews	Two weeks later	Incisional along inguinal canal. Type 3	1931 Willys Andrews	Yes Two months later
17	42	M	39	Right indirect inguinal hernia	1930 Bassini	2½ weeks later	Lateral to deep ring. Type 2	1931 Willys Andrews	No
18	62	M	58	Incarcerated right indirect inguino-scrotal	1929 Willys Andrews	Six weeks later	Incisional along inguinal canal. Type 3	1930 Willys Andrews	Yes Three months later
19	32	M	29	Right indirect inguinal	1930 Bassini	Four weeks later	Lateral to deep ring. Type 2	1931 Willys Andrews	Yes Six months later
20	50	M	48	Incarcerated right indirect hing. ernia	1931 Willys Andrews	3½ weeks later	Incisional along inguinal canal. Type 3	1932 Willys Andrews	No

Table 1 (*Continued*)

Case No.	Age	Sex	Age at 1st Operation	Original Diagnosis	Operative Procedure and Date	Time of So-called Recurrence	Type of Recurrence	Procedure	1 Yr. Later Recurrence and Date
21	79	M	77	Incarcerated right indirect inguinal	1931 Willys Andrews	Six months later	Incisional along inguinal canal. Type 3	1932 Willys Andrews	Yes
22	44	M	36	Right indirect inguinal	1925 Bassini	Eight months later	Bulge through Hesselbach's triangle. Type 4	1931 Willys Andrews	Yes Same
23	42	M	31	Left indirect inguinal	1922 Bassini	One year later	Lateral to deep abdominal ring. Type 2	1929 Willys Andrews	No
24	47	M	42	Right indirect inguinal	1928 Bassini	Two weeks later	Lateral to deep abdominal ring. Type 2	1931 Bassini	No
25	37	M	31	Left indirect inguinal	1927 Bassini	Four weeks later	Lateral to deep ring. Type 2	1930 Bassini	No
26	49	M	39	Right indirect inguino-scrotal	1923 Bassini	One year later	Lateral to deep ring. Type 2	1926 Willys Andrews	No
27	48	M	41	Right saddle-back	1926 Willys Andrews	Five weeks later	Lateral to deep ring. Type 2	1928 Willys Andrews	No
28	29	M	27	Left indirect inguinal	1931 Bassini	Ten days later while coughing	Left indirect inguinal. Type 1	1932 Bassini	No
29	37	M	33	Right scrotal incarcerated	1929 Bassini	Five weeks later	Lateral to deep ring. Type 2	1931 Willys Andrews	No
30	50	M	35	Right indirect inguinal	1918 Bassini	Six weeks later	Lateral to deep ring. Type 2	1924 Willys Andrews	No
31	52	M	36	Left scrotal	1917 Bassini	Four weeks later	Bulge through Hesselbach, s triangle. Type 4	1925 Willys Andrews	No
32	49	M	37	Right indirect inguinal	1921 Bassini	Six weeks later	Lateral to deep ring. Type 2	1933 Willys Andrews	No
33	64	M	57	Right indirect inguinal	1926 Willys Andrews	Eight weeks later	Lateral to deep ring. Type 2	1933 Willys Andrews	No
34	68	M	53	Right indirect inguinal	1918 Bassini	Fourteen years later in 1932	None. A femoral strangulated hernia	1933 Moshkowitz hernio-plasty	No
35	37	M	35	Right indirect inguinal	1931 Bassini	Four weeks later	Lateral to deep ring. Type 2	1932 Willys Andrews	No
36	42	M	40	Bilateral indirect inguinal	1931 Bilateral Bassini	Six weeks later on right side	Through Hesselbach's triangle on right side. Type 4	1932 Willys Andrews (right)	No
37	62	M	60	Right indirect inguinal scrotal	1931 Willys Andrews	Six weeks later	Postoper. incisional hernia along canal. Type 3	Willys Andrews	Yes
38	58	M	56	Left indirect inguinal scrotal	1931 Willys Andrews	Four weeks later	Postoper. incisional hernia along canal. Type 3	1932 Willys Andrews fascial suture (Gallie)	Yes
39	56	M	52	Left indirect inguinal saddle-back	1929 Willys Andrews	Eight weeks later	Lateral to deep ring. Type 2	1932 Willys Andrews (Gallie) fascial suture	No
40	43	M	32	Left indirect inguinal	1931 Bassini	Three weeks later	Left indirect inguinal. Type 1	1932 Bassini	No

Table 1 (*Continued*)

Case No.	Age	Sex	Age at 1st Operation	Original Diagnosis	Operative Procedure and Date	Time of So-called Recurrence	Type of Recurrence	Procedure	1 Yr. Later Recurrence and Date
41	47	M	37	Right saddleback	1923 Bassini	Five weeks later	Lateral to deep ring. Type 2	1933 Willys Andrews	No
32	44	M	42	Left indirect inguinal	1931 Bassini	2½ weeks later	Lateral to deep ring. Bulge. No sac. Type 2	1932 Willys Andrews	No
43	47	M	40	Right indirect inguinal	1926 Bassini	Six weeks later	Lateral to deep ring. Type 2	1930 Willys Andrews	No
44	41	M	36	Right indirect inguinal	1928 Bassini	Four months later	Lateral to deep ring. Type 2	1929 Willys Andrews	No
45	58	M	51	Left indirect inguinal saddleback	1926 Bassini	Three months later	Incisional along canal. Type 3	1931 Gallie	No
46	39	M	30	Right indirect inguinal. Left indirect inguinal	1924 Bilateral Bassini	Right side six weeks later	Lateral to deep ring. Right side. Type 2	1929 Willys Andrews	No
47	31	M	23	Left indirect inguinal scrotal	1925 Bassini	One year later	Left indirect inguinal. Type 1	1928 Willys Andrews	No
48	44	M	22	Right indirect inguinal	1911 Bassini	One year later	Right indirect inguinal. Type 1	1927 Willys Andrews	No
49	49	M	42	Left indirect inguinal scrotal	1926 Bassini	Three weeks later	Lateral to deep ring. Type 2	1930 Willys Andrews	No
50	64	M	50	Left indirect inguinal	1919 Bassini	Four weeks later	Incisional along inguinal canal. Type 3	1929 Willys Andrews	Yes Incisional hernia

the opening left for the cord; through the deep suture line above the pubis; or through the deep suture line in the middle of the wound lateral to the deep ring. In view of the foregoing statements one can see that the writer's views are somewhat different as to the nomenclature only. If the sac has been tied off properly there cannot be a recurrence. The width of the cord opening is not a causative factor for a returning sac formation. Here, as well as in the other places and lower down near the pubic spine our recurrences are postoperative inguinal incisional herniae. The last-mentioned type are quite common. The patients give evidence, visible, palpable and subjective (pain), before leaving the hospital as a rule, after their operation.

In Table 1 the writer has attempted to classify and chart a representative 50 cases of a large series in accordance with the ideas of recurrences of inguinal hernia as elaborated in this paper.

As an aid in examining these charts, the writer has designated the recurrences and so-called recurrences by types 1, 2, 3 and 4.

Table II

DISTRIBUTION OF CASES IN FOUR TYPES WITH AVERAGE AGE: TIME OF RECURRENCE

Type	Number of Cases	Average Age in Years	Type of Recurrence
1	6	27	Recurrence in all types from 10–40 days excepting a few isolated cases
2	25	38	
3	13	55	
4	5	35	
Femoral hernia....	1	53	

Type 1. A true recurrence of the previously operated upon condition, with definite sac found at second operation. (Figs. 2A and B.)

Type 2. A bulge lateral to deep ring, but no sac. (Figs. 5–7.)

Type 3. An incisional hernia along the inguinal canal. (Fig. 5.)

Type 4. A bulge through Hesselbach's triangle with no sac. (Figs. 7 and 8.)

We thus find 50 cases of so-called recurrences distributed as shown in Table II.

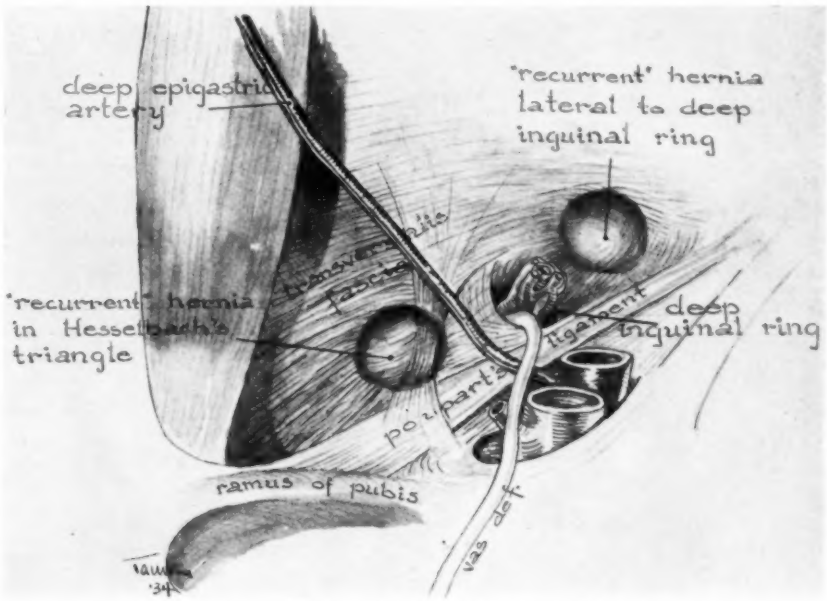

Fig. 5. Internal view of so-called recurrent hernias.

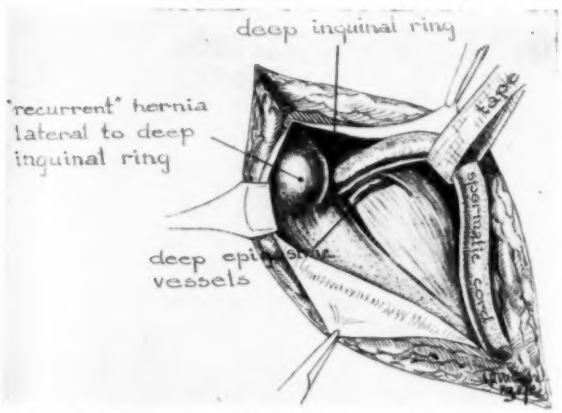

Fig. 6. "Recurrent" hernia lateral to deep ring.

In Table II, the writer has attempted to show that of the fifty so-called recurrences only 6 were true recurrences, while the major portion of the pseudo recurrences fall in types 2 and 3. The time of recurrence in 90 per cent of all the cases has been within forty days, with most recurrence visible before the patient leaves the hospital; the age group of type 3 is much higher than the other types.

In Table III, one sees at a glance that in the type of true recurrence we find no return of previous condition after the second operative procedure, while in the older age group (Type 3) of incisional hernia, we find 10 recurrences out of 13, after a few months interval.

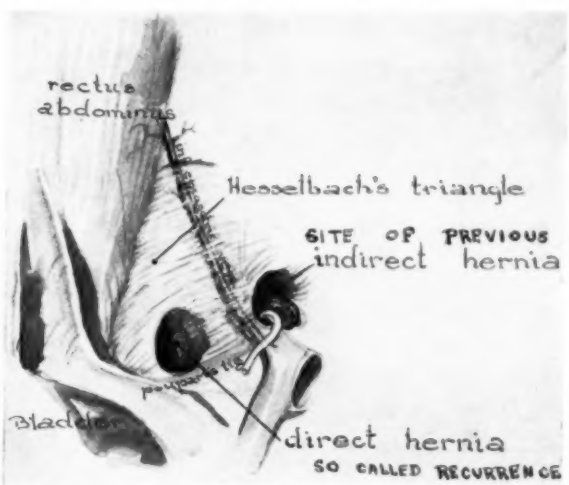

Fig. 7. Bulge in Hesselbach's triangle seen from within.

In attempting to review the literature on this subject, the writer was impressed by the fact that the various authors did not differentiate between true and false recurrences.

TABLE III
RELATION TO TYPES AND FURTHER RECURRENCE AFTER 2ND OPERATION

Type	Number of Cases	Recurrence After Second Operation
1	6	None
2	25	2
3	13	10
4	5	1

age group with poor musculature and obesity present; this must be borne in mind at the first operative procedure as re-operation usually yields another so-called recurrence.

4. Recurrences can be recognized as a rule within forty days after the operation.

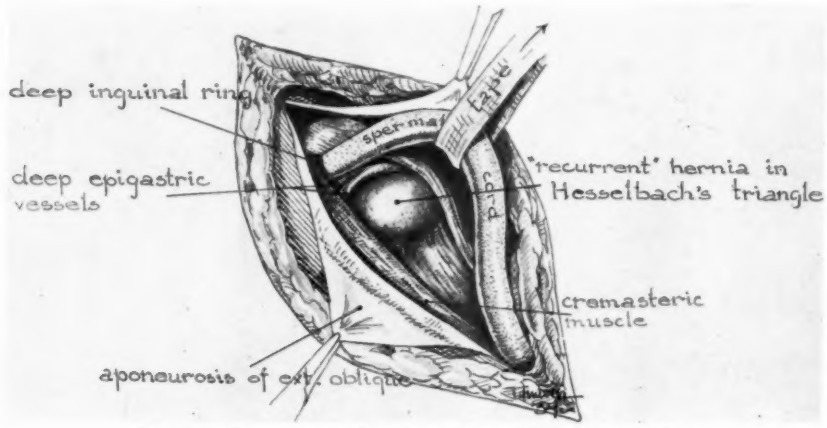

FIG. 8. "Recurrent" hernia in Hesselbach's triangle.

SUMMARY

1. So-called recurrences after inguinal hernia operation are not true recurrences at all.

2. True recurrences with definite sac formation, are a very small percentage of so-called recurrences.

3. Incisional herniae occur in an older age group with poor musculature and obesity present; this must be borne in mind at the first operative procedure as re-operation usually yields another so-called recurrence.

4. Recurrences can be recognized as a rule within forty days after the operation.

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SURGERY OF THE DIABETIC

PREOPERATIVE AND POSTOPERATIVE MANAGEMENT OF THE DIABETIC SUBJECTED TO SURGERY

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THE purpose of this paper is to make a plea for a standardized hospital routine for the care of diabetics subjected to surgery with the responsibility vested solely in the surgeon until the surgical period is over.

The following considerations will be discussed in order:

1. General considerations in regard to diabetes, and the fundamentals underlying the care of a diabetic with which the surgeon should be familiar
2. Considerations in preparation for elective surgery
3. Considerations in preparation for emergency surgery
4. Considerations in case of complications developing postoperative
   a. Acidosis
   b. Alkalosis
5. A suggested hospital routine
6. Summary
7. Conclusions.

Would it not be simpler, especially in a large surgical ward, to have a routine standing treatment for all surgical diabetics, drawn up by the internist and supervised by him, but carried out by the surgical house staff under the direction of the surgical attendant? With such a plan in effect, the surgeon is able to judge more accurately the relation of the diabetes to the surgical wound, as well as the effect of the local disease upon the diabetes.

Since surgical diabetic mortality is more than three times that of the non-diabetics, the surgical diabetic should have three times the attention. The surgeon usually is not to blame because the patient comes to him too late for proper treatment.

It is unfortunate that diabetics are often denied early life-saving surgical intervention, such as appendix and gall-bladder operations in the local hospitals. They are sent to a few hospitals where surgery can be performed under special conditions. If the internist and surgeon know their special problem, they should not be afraid of the diabetic.

Joslin says:[4]

> Diabetic coma is a needless complication of diabetes, and "arises through ignorance or neglect of the simplest rules of medical treatment on the part of the patient or the physician and when it occurs, recovery is almost invariable if appropriate measures are employed. Facts prove that diabetic coma can be abolished."
>
> Coma comes from over-eating either of food or one's own body. Over-eating of food is usually the result of breaking the diet, but not always is this true today. The modern diabetic who takes insulin is always over-eating, so far as his own capacity is concerned, and so soon as insulin is omitted he is liable to coma. Therefore, no insulin diabetic should omit insulin unless sugar free and insulin should be resumed when sugar returns. Even if the insulin diabetic takes no food, he should not omit insulin unless sugar free and should be ready to resume it, if the glycosuria recurs, as demonstrated by four, six or eight-hour tests of the urine.

As clinical observations indicate, and as Allen and Wilshart have shown in their extensive experimental work on dogs, diabetic acidosis is not the result of a mere intoxication with acetone bodies, or of poisoning with acid, but is due rather to some metabolic derangement of which the

chemical signs are only a superficial and variable expression.

A supply of glycogen stored in the liver is vital to the diabetic. With it, his life is secure; without it, he dies. With glycogen in the liver, he is a mild diabetic; without it, he becomes a severe diabetic; the liver fills with fat, and acidosis appears. In the administration of insulin, it is better to give too little and thus avoid a hypoglycemic shock on the operating table.

A moderate acidosis, according to Joslin, is represented by the excretion of 5–10 gm. of *B*-oxybutyric acid, the elimination of 2 gm. of ammonia, or a fall of carbonic acid in the alveolar air to 4 per cent, the equivalent of 29 mm. of mercury. Acidosis is considered severe whenever *B*-oxybutyric acid excretion reaches 30 gm., ammonia excretion 5 gm. in twenty-four hours, or when the carbon dioxide tension of alveolar air is 3 per cent (22 mm. mercury), or the volume per cent of CO_2 in blood under 30.

Routine management of diabetics subjected to surgical operations should be standardized as much as possible so as to avoid confusion. It has been the rule to have the internist and surgeon in joint attendance which leads to division of responsibility and often less efficient care than if the responsibility were placed entirely on the surgeon. With a comprehensive set of standing orders prepared in advance by one trained in the care of diabetic cases, or preferably, the internist who has been in direct control of the case requiring surgery, the surgeon may then proceed to take full charge of the case, regulating the diet and insulin dosage in respect to the surgical problem presented. If some unusual complication arises such as symptoms of impending coma, the internist might be called in consultation. The internist usually prescribes entirely for the control of the diabetes, and perhaps never sees the surgical lesion postoperatively, or, if he does see it, does not recognize its full importance. On the other hand, the surgeon usually takes it for granted that the diabetes is well under control, and regards only the local lesion as his responsibility. Perfect cooperation would obviate these mistakes, it is quite true, but perfect cooperation is frequently an ideal, not a fact, and with the best will in the world on the parts of all concerned, it is often not achieved.

PREOPERATIVE CARE OF ELECTIVE SURGERY

Preoperative care of elective surgical operations should consist of proper medical management for at least one week with the following objects in view:

Blood sugar within normal limits.

No sugar or acetone in the urine.

The evening before operation, transfer the case to the surgeon where he will receive the usual preoperative orders as a non-diabetic, with the following exception: Two hours preoperative, the diabetic is given from 6 to 10 ounces of orange juice and from 10 to 20 units of insulin, depending upon the severity of the case. Insulin is usually given approximately 1 unit for each 2 gm. of sugar formers in the diet; if the CO_2 combining power of the blood is less than 40 volumes per cent, 10 gm. of glucose are given in the vein together with 5 units of insulin immediately before or during the operation. The anesthetic of choice is local or spinal. Nitrous oxide, gas or ethylene are very good. Ether is theoretically bad for diabetics as it tends to increase the acidosis. Chloroform is seldom used.

PREOPERATIVE CARE OF EMERGENCY SURGERY

Emergency surgery, accidents, infections, abortions, etc., are a more serious problem for the diabetic. The patient is usually presented to the surgeon in a state of shock with no time for preoperative preparation. Frequently laboratory facilities are lacking with the exception of a simple urinalysis.

It is necessary to mention a word of caution regarding the diagnosis of an acute surgical abdomen. The patient may have a high temperature, nausea, and vomiting,

high white blood counts and a rigid abdomen but if the urine contains sugar and acetone, give 15 to 25 units of insulin every hour until the urine is sugar free. If the acute surgical symptoms are still presented, then proceed with the surgery. A leucocytosis may be the sign of a diabetic coma and not an abscess of the appendix. Berglund's case showed 100,000 leucocytes with many immature forms and these all withdrew from the blood stream upon recovery from the coma. The management of these acute surgical conditions can not wait upon the careful preoperative preparation of the elective surgical case, and in addition to the usual surgical orders, the administration of insulin, if there is sugar in the urine, from 5 to 20 units depending upon the amount of reduction and in the presence of acetone and diacetic acid, the subcutaneous or intravenous injection of glucose solution, with appropriate dosage of insulin, should be carried on with the thought in mind to first clear up the acetone, then the sugar, from the urine as quickly as possible.

In the presence of infection, particularly of the skin, diabetic acidosis is increased and without the adequate supply of available glucose and insulin, the infection is very stubborn to treatment. For this reason, I feel that the surgeon is better qualified to take full responsibility of the insulin dosage and glucose administration as he has a much better perspective, not only of the surgical condition at hand, but as to the patient's response to his treatment compared with the non-diabetic.

POSTOPERATIVE CARE

Postoperative treatment differs from the non-diabetic surgical case in two respects:

The urine must be examined at three hour intervals for sugar, acetone, and diacetic acid. This may be done by an interne or laboratory technician who is kept in constant touch with the case. The surgeon should visit the case postoperatively at least three times a day to check on the condition of the operative wound as well as the general condition of the patient. If infection occurs, which is quite frequent in diabetics, acidosis must be guarded against. If sugar appears in the urine as evidenced by a bluish-green color, we may roughly say that there is about 1 per cent sugar in the urine, in which case the patient should receive 5 units of insulin. If the urine reduces to an orange or reddish color, there may be from 1 to 10 per cent sugar in the urine, in which case he would receive from 5 to 15 units of insulin. If the patient has been taking a large quantity of insulin before the operation, the same dose should be continued, but the intervals of injection should be every three hours and the total intake of insulin for the twenty-four hours should be equal to his regular dose. If acetone appears, 6 ounces of strained orange juice should be given by mouth if he is able to swallow, if not, 10 gm. of glucose intravenously and 5 units of insulin.

ACIDOSIS

If symptoms of acidosis or impending coma appear, namely—headache; deep slow and prolonged inspiration and short expiration with short pause between; restlessness; absent patellar reflexes; soft eyeballs with profuse perspiration and drowsiness; a test of the CO_2 combining power of the blood should be taken. If below 40 volumes per cent, repeat the intravenous glucose with insulin to split it until the ketone bodies are no longer present in the urine.

If the urine becomes sugar free and the blood-sugar near 150 mg. per 100 c.c. of blood and acidosis is still present, insulin injections of 5 to 15 units covered with glucose either by mouth in the form of orange juice, or subcutaneously in 3 to 5 per cent solution, or intravenously 5 to 25 per cent glucose solution. If the patient is dehydrated, as is often the case in coma or impending coma, the use of adequate liquids subcutaneously along with glucose is indicated. If the patient is waterlogged or has a weak heart muscle, the intra-

venous administration of the concentrated glucose solutions is preferable. The average case requires from 3,000 to 4,000 c.c. of fluid every twenty-four hours. Glucose per rectum is poorly absorbed and should not be used if an immediate supply of glucose is wanted.

Opinions as to whether or not dextrose should be given intravenously are about equally divided among different workers. An individual with a blood sugar of 500 has about 30 gm. of dextrose in his circulation. If 250 c.c. of a 10 per cent solution of dextrose are given intravenously, 25 more grams of dextrose are added, so that 55 gm. are in circulation. To take care of this amount of dextrose, about 28 units of insulin would be required. If from 50 to 100 units of insulin are added to the solution, it is more than enough to take care of this amount of added carbohydrate. That the added dextrose does not embarrass the patient is evidenced by the subsequent steady fall of the blood sugar content, the disappearance of acetone and the rise of carbon dioxide. The purpose of the dextrose solution is to add fluid to the dehydrated body, to increase the excretion of urine, which is usually markedly lowered, and through this to wash out a certain amount of acid bodies. By means of dextrose, oxidation in the blood stream and the tissues is increased, and this increased oxidation helps to burn up acid bodies. The glycogen-poor liver also is restocked with glycogen, which in itself is an important factor in lessening the acidosis.

ALKALOSIS

After the acidosis is under control, there is some danger of alkalosis which may be safeguarded against by an adequate administration of normal sodium chloride solution under the skin or in the vein.

There has been considerable controversy among the best men on diabetes concerning the administration of alkalis in this condition. Joslin opposes it, particularly large doses. On the other hand, Allen urges their use. Bock and Fitz recommend from 15 to 35 gm. of sodium bicarbonate in twenty-four hours as a routine; not because all patients require it, but because a certain percentage of their coma cases after being relieved of ketogenic acidosis, still have an acidosis which they believe is caused by an unidentified organic acid and that this acid is neutralized by alkalis. For this reason they give it routinely for fear that if it is not given, the patient may die from acidosis, other than ketosis. Allen's method is the best in that he gives sufficient alkalis to keep the CO_2 combining power of the plasma as nearly normal as possible, which is 55 to 75 volumes per cent. In this way, the alkali deficit is restored and at the same time alkalosis is prevented. If the facilities are not at hand for doing this test, we should be guided by the urine, which should be kept neutral or slightly alkaline. The cardinal findings that should make one suspect alkalosis are:

1. The presence of vomiting with subsequent loss of fluid from upper intestinal tract
2. Loss of fluid by fistula, gastric, duodenal or jejunal
3. History of preoperative ingestions of large quantities of alkali
4. Great prostration and weakness tending to coma
5. Presence of signs of tetany.

These signs should call for investigation of the blood chemistry by which alone a positive diagnosis can be made and acidosis and uremia ruled out.

As soon as possible the surgeon should return the patient to the internist who will resume the regular diabetic management and insulin dosage with the idea of getting the patient back on his feet as soon as possible.

SUMMARY

Preoperative Treatment: Every patient with diabetes who is operated upon should be regarded as a candidate for coma and its prevention is better than the cure. A high carbohydrate intake for a period of one week before operation should be the rule

unless a surgical emergency arises. The carbohydrate intake varies with the individual patient but, in my opinion, should never be less than 150 gm. in twenty-four hours and, if the patient is obese, should be as high as 225 gm. Insulin is used in any amount necessary to control any glycosuria that may arise.

Postoperative Treatment: When the patient returns from the operating room, he should receive approximately the same amount of insulin in twenty-four hours which he was receiving on his regular diet. Glucose should be given in amounts equal to his sugar producing intake on his regular diet. Insulin should be given in small repeated doses so that at least 75 gm. of glucose are metabolized every twenty-four hours in the average patient, but in the obese, 150 gm. of glucose should be metabolized. All urine is tested for the presence of sugar and diacetic acid. The plasma CO_2 combining power is estimated whenever there is any clinical evidence of acidosis. If the acidosis is under control and symptoms of alkalosis occur, namely, prostration and tetany, a close check should be kept of the CO_2 capacity of the blood. The slightest acidosis or alkalosis must be combated vigorously.

CONCLUSIONS

1. The surgeon should bear the brunt of responsibility in operating on diabetic patients.

2. The proper selection and judicious administration of anesthetics, good surgical technique that avoids unnecessary trauma and delay, contribute greatly to reducing the operative risks of diabetics in surgery.

3. Patients with diabetes who undergo operations are very susceptible to acidosis, but this danger can be practically eliminated by frequent urinalyses and proper treatment.

4. The healing of operative wounds is somewhat delayed due to the peculiar lack of resistance to skin infections even in well-controlled diabetics. The healing of chronic ulcers or indolent wounds requires the closest application of surgical technique plus control of sugar metabolism. Most patients with diabetes, particularly those requiring surgical procedures, are advanced in years, overweight and suffering from circulatory disturbances and other degenerative lesions which, of themselves, make the surgical risk serious.

5. In view of these considerations, it seems to me that such patients who require surgery should be under the control of the operating surgeon in a well-managed medical center, in cooperation of internist, interne, laboratory and dietitian. In emergency surgery, delay in transporting patient to the medical center is often fatal and the surgery should be performed as quickly as possible by the first available surgeon, whose results will be satisfactory if he guards against acidosis and alkalosis.

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STUDY OF THE

MORBIDITY AND MORTALITY IN 272 HYSTERECTOMIES

PERFORMED IN A PRIVATE HOSPITAL BY 29 DIFFERENT SURGEONS

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THIS study of hysterectomies was undertaken in an effort to determine factors of weight in reducing the morbidity and mortality accompanying hysterectomy. The records of the Southern Baptist Hospital revealed 272 hysterectomies performed there over a period of six and a half years.

Twenty-nine different surgeons performed these operations. Of the total number, 202 were performed by four staff surgeons and their associates. The remaining 70 were done by 25 different surgeons having smaller services. (Table I.)

TABLE I

Service	*Number of Operations*	*Per Cent*
A	117	42.9
B	35	12.8
C	33	12.0
D	17	6.3
4 surgeons and associates	202	74.0
25 remaining surgeons	70	26.0

INCIDENCE OF SYMPTOMS

Similarity to the findings of other men was noted in the incidence of symptoms. Abdominal pain and bleeding occurred most frequently, pain being present in 47 per cent of the cases and bleeding in 37 per cent. (Table II.)

TABLE II

INCIDENCE OF SYMPTOMS

Symptom	*Per Cent of Cases*
Pain in abdomen	47.5
Metrorrhagia	37.7
Tumor	24.2
Dysmenorrhea	19.0
Leucorrhea	16.0
Urinary disturbances	13.9

INCIDENCE OF DIAGNOSIS

The diagnosis of fibroid was made in 70 per cent of the cases and of salpingo-oophoritis in 32 per cent. This is in correspondence with the report of Samuels and Edlavitch of Baltimore who report 85 per cent of uteri removed for myoma, chronic pelvic inflammation and malignancy in their series of 303 abdominal hysterectomies.[5] (Table III.)

TABLE III

INCIDENCE OF DIAGNOSIS

Fibroid	70.9
Salpingo-oophoritis	32.3
Appendicitis (accompanying)	25.3
Cystocele	20.9
Lacerated perineum	20.6
Cervicitis	20.2
Endometritis	13.6
Ovarian cyst (Samson's chocolate)	11.0
Rectocele	10.3
Retroversion	9.5
Procidentia	6.6
Miscellaneous	5.9
Polyps	3.6
Ectopic pregnancy	1.1
Dermoid cyst	.36

TYPES OF OPERATIONS

This series of cases includes panhysterectomy, supravaginal hysterectomy, vaginal hysterectomy and fundectomy, the term panhysterectomy meaning, of course, complete removal of the uterus without reference to surgery of the adnexa, supravaginal hysterectomy, removal of the uterus at the level of the internal os, and fundectomy, excision at the level of the tubes. It was naturally difficult to determine the exact interpretation which the various

surgeons gave these terms, but this classification was used and showed that the 272 operations consisted of 179 supravaginals,

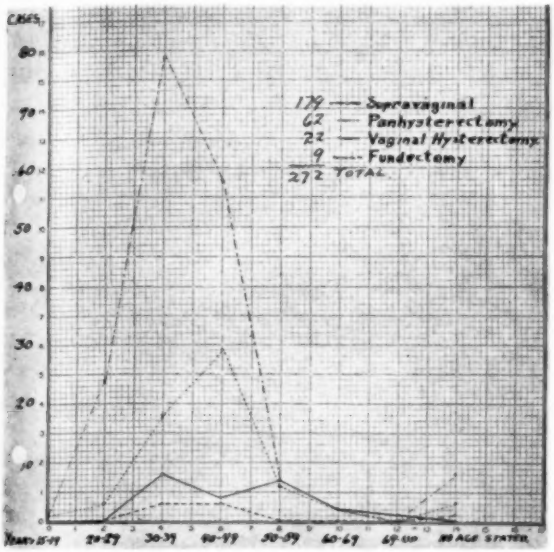

Chart 1. Relationship as to age groups and number of each type of operation done.

62 panhysterectomies, 22 vaginal hysterectomies, and 9 fundectomies.

TYPES OF OPERATIONS IN RELATION TO AGE GROUP

The types of operations were listed in relation to the various age groups, beginning at ages fifteen to nineteen and continuing through sixty-nine, with one additional group for those whose age was not stated (Chart 1). The highest proportion of the supravaginal operations, 44.1 per cent, was done between thirty and thirty-nine years. It is interesting to note that at this age the mortality was 1 per cent, with 44.1 per cent of the supravaginals performed, whereas that for the forty to forty-nine year age group was 4 per cent, although only 32.4 per cent of the supravaginals was performed at this age. The highest percentage of panhysterectomies, 46.4 per cent, was done between forty and forty-nine. At the forty-nine to fifty-nine year group, the total number of operations naturally declined. Vaginal hysterectomy, however, showed an increase at this age. (Charts 2 and 3.) Its desirability for older women in whom abdominal surgery carries a high degree of risk accounts for the increase at this age. (Table IV.)

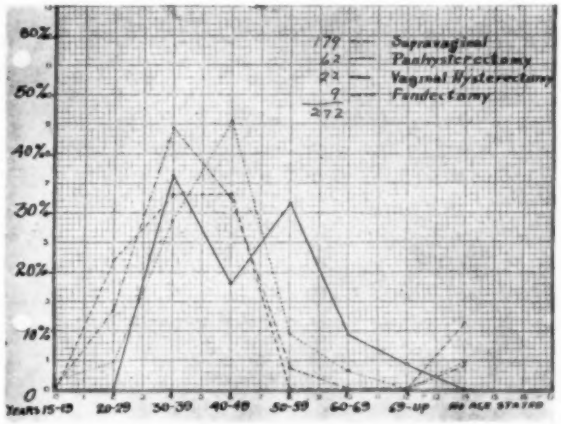

Chart II. Relationship as to age groups and percentage of each type of operation done.

MORBIDITY

Morbidity was determined by taking a temperature of 101° F. as a basis, as other observers have done. In 105 patients, more

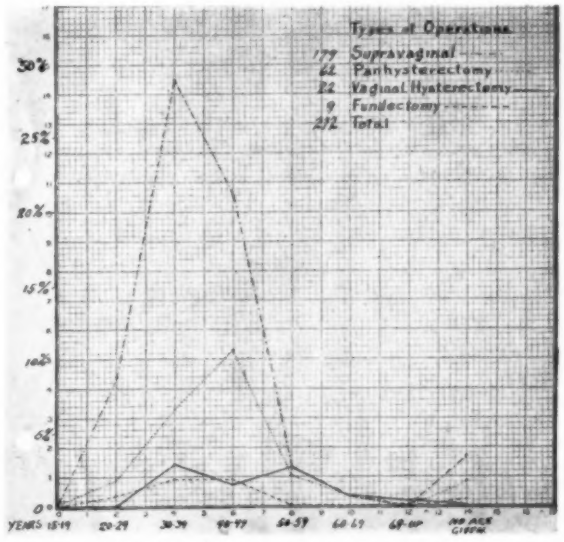

Chart III. Relationship as to age groups and percentage of all types of operations done.

than one-third of the series, the temperature was never above 101°F.; 64 had a temperature above 101° for one day, and 103 for more than one day.

Morbidity was severest in the vaginal type of hysterectomy, slightly more than half, 54.5 per cent, having a temperature over 101° for several days. This is especially

interesting in view of the fact that there were no fatalities at all in this group. We believe this may be explained as due to postoperative complications resulting from the greater age and poorer condition of these patients. In the panhysterectomy group, 48.3 per cent had a temperature of 101° more than one day; in the fundectomy group, 44.4 per cent had several days' fever; and the supravaginal group showed 31.9 per cent with temperature over 101° for more than one day (Table v.)

Table IV
AGE INCIDENCE AND TYPE OF OPERATION

	15–19	20–29	30–39	40–49	50–59	60–69	69 Up	Not Stated	Total
Supravaginal	1	24	79	58	7	2	0	8	179
Panhysterectomy	1	3	18	29	6	2	0	3	62
Vaginal	0	0	8	4	7	2	1	0	22
Fundectomy	0	2	3	3	0	0	0	1	9
	2	29	108	94	20	6	1	12	272

Table V
MORBIDITY IN RELATION TO TYPE OF OPERATION

Temperature (F.)	Supravag.	Panhyst.	Fundect.	Vaginal	Total
Never above 101°	77	20	4	4	105
One day above 101°	45	12	1	6	64
Several days above 101°	57	30	4	12	103
Total	179	62	9	22	272

Of the total number of cases, 38 per cent showed no rise in temperature, 23 per cent one day's fever and 37 per cent several days' temperature. (Table vi.)

Table VI
PERCENTAGE OF MORBIDITY IN RELATION TO TYPE OF OPERATION

Temperature (F.)	Supravag.	Panhyst.	Fundect.	Vaginal
Never above 101°	43.0	31.3	44.4	18.3
One day above 101°	25.1	19.4	11.1	27.2
Several days above 101°	31.9	48.3	44.4	54.5

PERIOD OF HOSPITALIZATION

The period of hospitalization was shortened only slightly by vaginal hysterectomy. The group subjected to this procedure averaged 12.9 days' stay in the hospital, whereas the abdominal groups averaged 13 days and 14.6 days. Certain other observers report a greater saving of time than this. (Table vii.)

Table VII
PERIOD OF HOSPITALIZATION

179 cases of supravaginal type averaged 13 days in hospital
62 cases of panhysterectomy averaged 14.6 days in hospital
22 cases of vaginal type averaged 12.9 days in hospital
9 cases of fundectomy averaged 16 days in hospital

SPINAL ANESTHESIA

Spinal anesthesia was given in 7 of the 272 operations. Two deaths occurred in this group, one of which was attributed to shock, and the other to acute suppression of urine.

In connection with the death attributed to shock, it is interesting to mention the work of Burch which indicates that spinal

anesthesia increases the danger of shock. He believes that in most cases of so-called surgical shock, hemorrhage is either the chief or a contributing factor. By causing paralysis of a good portion of the vasomotor system of the body, spinal anesthesia prevents vaso-constriction, the normal compensatory mechanism of the body against hemorrhage, and this increases the danger of shock from excessive loss of blood. Avoidance of blood loss, he believes, would eliminate shock as a factor in pelvic surgery.[1]

MORTALITY

In the series of 272 hysterectomies, there were 12 deaths, a mortality of 4.4 per cent. Five of these deaths occurred in the supravaginal group, 2.8 per cent mortality; 6 in the panhysterectomy group, 9.6 per cent mortality; one in the fundectomy group, 11.1 per cent; and none among the vaginal hysterectomies. It should be mentioned, however, that the small size of the fundectomy group is responsible for the high mortality, there being one death in 9 cases.

With reference to age groups, there was one death, a panhysterectomy, between the ages of fifteen and nineteen; none between twenty and twenty-nine; two, one supravaginal and one panhysterectomy, between thirty and thirty-nine; six, four supravaginals, one panhysterectomy and one fundectomy, between forty and forty-nine; one, a panhysterectomy, between fifty and fifty-nine; one, a panhysterectomy, between sixty and sixty-nine; none from sixty-nine up; and one, a panhysterectomy, in the group in which no age was stated. It is interesting to note that at ages thirty to thirty-nine the highest number of operations, 108, was done with only two deaths resulting, and that in the next age group, forty to forty-nine, in which only 94 operations were performed, six deaths resulted. (Table VIII.)

Of the twelve deaths in the series, seven occurred in the group of 202 operations by four surgeons and their associates, a mortality of 3.5 per cent. The remaining five deaths were in the 70 operations performed by 25 different surgeons, a mortality of 7.1 per cent. (Table IX.)

In the 117 operations performed by one of the authors, Sellers, and his associate, there were two deaths. One of these patients was pronounced by the anesthetist a poor surgical risk, with blood pressure index of 1 and energy index .21, both higher than normal. Pressure symptoms and the size of the mass, however, made it

TABLE VIII
MORTALITY IN RELATION TO AGE AND TYPE OF OPERATION

	15–19	20–29	30–39	40–49	50–59	60–69	69 Up	Not Stated	Per Cent
Supravaginal	0	0	1	4	0	0	0	0	2.8
Panhysterectomy	1	0	1	1	1	1	0	1	9.6
Vaginal	0	0	0	0	0	0	0	0	0
Fundectomy	0	0	0	1	0	0	0	0	11.1
	1	0	2	6	1	1	0	1	

TABLE IX
MORTALITY IN RELATION TO SURGEON

Surgeon	Cases	Deaths	Mortality (Per Cent)
A	117	2	1.7
B	35	3	8.6
C	33	0	0
D	17	2	11.1
Group E (25 surgeons)	70	5	7.1

necessary to operate in spite of his unfavorable report. The mass was incarcerated in the pelvic cavity and was removed with great difficulty. Only supravaginal hysterectomy was done and the patient left the table in fair condition. She died two days later. Partial autopsy showed that there were no abdominal complications. The other death was due to endometriosis complicated by chronic inflammatory disease. Blood pressure index was .50 and energy index .14, both normal. Hysterectomy was performed only to facilitate removal of the pelvic mass. The patient died seven days later of peritonitis and bronchial pneumonia.

The other three surgeons in the group of four had 85 cases with five deaths. Of these, two were attributed to postoperative intestinal obstruction, one to postoperative ileus, one to peritonitis, and one to disruption of the abdominal wound.

In the 70 hysterectomies performed by 25 different surgeons, five deaths occurred. Two were due to shock, one to carcinoma, an old malignant papillo-adenocystoma secondarily infected being present, one, that of a seventeen year old girl, to acute suppression of urine, and one to acute glomerular tubular nephritis and acute toxic myocarditis.

CORRECTED MORTALITY

Eliminating the death due to endometriosis and chronic inflammatory disease in which hysterectomy was done only to facilitate removal of the mass, and the death due to carcinomatous condition complicated by preoperative partial intestinal obstruction, there were ten hysterectomy deaths in the series of 272 operations. This is a corrected mortality for the series of 3.7 per cent. This mortality compares very favorably with that reported in other studies, especially in view of the fact that these operations were performed by 29 different surgeons. Fullerton and Faulkner estimated from a study of 5400 cases collected in the literature that hysterectomy in the best hands should not have a mortality of over 2.5 or 3 per cent in selected cases.[2] Miller, however, states from his study of hysterectomies that with the average surgeon, who does the majority of operative work in the United States, mortality is usually from 5 to 8 per cent and may be as high as 8 to 10 per cent, the low mortality rates reported in the literature being those of skilled surgeons and of the larger clinics and hospitals.[4] Corrected mortality figures for this series are as follows: entire series, 3.7 per cent; four surgeons and their associates 2.9 per cent; 25 remaining surgeons, 5.7 per cent. (Table x.)

TABLE X
CORRECTED MORTALITY

Group	*Hysterectomies*	*Deaths*	*Mortality (Per Cent)*
4 surgeons and associates	202	6	2.9
25 different surgeons.....	70	4	5.7
29 surgeons (entire series)	272	10	3.7

FACTORS IN REDUCTION OF MORBIDITY AND MORTALITY

Careful analysis of the personal group of 117 operations performed with a corrected mortality of less than 1 per cent (Sellers and Sanders) leads us to form the opinion that the observance of certain precautions is equally as important as the necessary technical skill in keeping morbidity and mortality rates low.

Preoperative preparation should include complete physical examination with kidney function test and blood picture. The sedimentation test is not only diagnostic, as is the blood count, but is of even greater value than the count in determining when the patient is ready for surgery.

Blood transfusions are of inestimable value as a preventive measure for shock. Substandard risks and patients who are constantly losing blood should be given repeated transfusions before surgery is attempted. In selected cases of excessive

bleeding, it is necessary to perform a curettage and give a small, non-castrating dose of radium prior to operation.

Hysterectomy is often indicated at an age when the patient is a substandard risk because of such conditions as secondary anemia, cardiorenal disease or an unstable nervous system. For this reason, it is essential to have a capable anesthetist or internist estimate the resistance of the patient before operation. This is especially true if extensive work is indicated, as is usually the case in patients with birth canal injuries. This preoperative estimation of surgical risk was furnished in the majority of the personal cases reviewed through the determination of the blood pressure index, the energy index and the shock index by the anesthetist, Dr. Ansel Caine, before operation was undertaken or the method of anesthesia decided upon.

The blood pressure index is determined as follows:

> The systolic and diastolic pressures are taken by the usual ausculatory method. The pulse pressure is found by subtracting the diastolic from the systolic pressure. The blood pressure index is a fraction having the pulse pressure for numerator and the diastolic pressure as denominator. With healthy patients this index is very constant and has a value of 50/100. The index is lowered in myocarditis and in traumatic shock. It is increased in aortic regurgitation, in toxic goiter and in nephritis. . . .
>
> Moots gives the following rule for use of the blood pressure index in estimating surgical risks: if the blood pressure index is between .25 and .75 the case is operable. If it is less than .25 or greater than .75, the case is inoperable. Albert Miller found that in 1000 routine cases the mortality for operable cases was 3.23 per cent whereas that for inoperable cases was 23.07 per cent. Ruth of Philadelphia, in a similar study, found that the mortality in operable cases was 0 and in inoperable cases 40 per cent. Moot's rule is of distinct value. . . .
>
> The energy index is a development of the blood pressure index. It is determined by multiplying the sum of the diastolic and systolic pressures by the pulse rate per minute. Disregarding the three last figures of the result, the normal energy index is 16. It represents the energy expended by the circulatory system in one minute. The normal limits are 12 to 18.[3]

The shock index is determined according to the method of Froe. The systolic pressure multiplied by 100 forms the numerator and the hemoglobin index multiplied by the number of 100,000 red blood cells the denominator. The resultant figure is the shock index. This should not be over 7.

For patients classed as substandard risks, as well as for elderly obese women, vaginal hysterectomy is highly desirable. The danger of postoperative complications such as hernias and infection is reduced, shorter operative time is required, local anesthetic may be used, the mortality rate is lower and the end-results are better than in abdominal hysterectomy. Under no conditions, however, should the indications be forced, and vaginal hysterectomy should never be performed in the presence of adnexal disease, contracted vagina, abnormally large uterus, or when the broad ligaments are not sufficiently elastic. In skilled hands, vaginal hysterectomy is a safer procedure than abdominal hysterectomy provided these precautions are observed.

We shall not discuss the details of operative technique, but wish to emphasize the importance of one procedure. The surgeon himself or his first assistant should scrub the vaginal vault thoroughly before operation. At this time, he can again determine the condition of the cervix; if it is normal in appearance of if the pathology is only slight, the endocervical glands may be reamed or coned out with the electrosurgical unit and supravaginal hysterectomy done. In his follow-up of these cases, Sellers has had no case of cancer of the cervix develop following this procedure.

CONCLUSIONS

1. In 272 consecutive hysterectomies performed at the Southern Baptist Hospital by 29 different surgeons, the corrected mortality for the series was 3.7 per cent.

2. Corrected mortality for the various operative procedures was as follows: vaginal hysterectomy 0; supravaginal hysterectomy 1.6 per cent; panhysterectomy 9.6 per cent; and fundectomy 11.1 per cent.

3. Morbidity was severest in the vaginal type of hysterectomy, probably because of postoperative complications due to the poorer condition and greater age of these patients.

4. Provided the contraindications to vaginal hysterectomy are observed, it is a safer operative procedure in skilled hands and gives better end-results than abdominal hysterectomy; it is especially valuable for substandard risks and elderly patients.

5. The morbidity and mortality accompanying hysterectomy may be lowered by careful preoperative preparation of the patient, including routine laboratory work, blood transfusion as a preventive measure for shock, and estimation of the surgical resistance of the patient by a capable anesthetist or internist; and by careful selection and administration of the anesthetic agent, together with the necessary technical skill.

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RECTAL ANALGESIA IN OBSTETRICS*

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THERE still exists wide divergence of opinion among obstetricians as to the merits of rectal analgesia as a routine procedure in the conduct of labor. The purpose of this study was to evaluate, by as careful and accurate methods as are at our disposal, the advantages and disadvantages of this type of obstetrical analgesia. We were particularly concerned to know whether this procedure had a tendency to lengthen labor, alter in any way its normal progress and termination, or harbored elements of danger to mother and child. The necessity for the establishment of these facts, is, of course, evident, before the routine employment of such an analgesia could be regarded as justifiable. Furthermore, should its use be advocated it should meet certain very definite requirements; it should relieve apprehension and furnish satisfactory analgesia in a large percentage of patients; facilitate labor or at least not interfere with the normal mechanism of labor; be equally safe for mother and child and protect them throughout labor. With these factors in mind I have collected and studied a series of 400 cases over a period of one year dating from the opening of the hospital in September, 1932, and have compared them with a similar number of routine clinic patients who did not receive rectal analgesia.

The history of the development of anesthesia is as brilliant and colorful as it is cautious, painstaking and protective. The portion of this history of anesthesia that deals with its application to obstetrics, differs from that of anesthesia as it relates to general surgery in one interesting aspect, namely, that it has always been besought with glaring problems, chiefly of opposition; folklore and superstitions, by laity and clergy as well as members of the medical profession who succeeded in delaying its development and its acceptance as rapidly as anesthesia in general. C. H. Davis gives a masterly and complete review of the development of anesthesia, both general and as it applies to obstetrics; he says: "Medical literature shows that practically every sedative, narcotic, and anesthetic drug in the Pharmacopoeia has been used for the relief of pain in childbirth."

Simpson, in 1847, used ether to alleviate the pain associated with childbirth. Nitrous oxide was first used by Klikowitsch in 1880 and was further used by Winchel of Dresden in 1881. Although nitrous oxide was first used by Winchel it was popularized in obstetrics by Webster, Lynch and Davis at the Presbyterian Hospital in Chicago and by Guedel in Indianapolis. Other forms of anesthesia were used and for a while held a certain number of disciples. In 1889 spinal anesthesia was introduced into surgery and shortly thereafter into obstetrics by Sinclair, Hopkins and others. Ethylene-oxygen was first used as an analgesic agent in obstetrics in 1923.

In 1902 Von Steinbuchel introduced the use of morphine and scopolamine in obstetrics. Gaus reported similar medication and spent much time developing a technique which, in his hands, gave satisfactory results in from 70–90 per cent of his patients. However, the popularity accorded this Dämmerschlaf, or twilight sleep, and its use by the general practitioner, aided by the press, invoked certain well-founded objections to its universal use, and the history of its gradual abandonment is well known.

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Pirogoff, a Russian, used ether in the rectum to produce analgesia as early as 1847. In 1923 Gwathmey modified the technique so as to make its use practical. This so-called "Gwathmey analgesia" consisted of morphinization in combination with magnesium sulphate hypodermically and colonic ether-oil. Gwathmey and his co-workers, Donovan, O'Regan and Cowan, stated that their reliance was placed on the synergistic action of the drugs used for its major effect. In 1924 Gwathmey, McKenzie and Hudson published a second paper adding to their first series of cases. Davis in 1925 set down the criteria this analgesic fulfilled and pointed out that Gwathmey's object was that of "ameliorating pain by a harmless, inexpensive method, which could be used by a physician without special training, in the home or hospital, and which would employ drugs in common use." Harrar in 1925 reported the use of this procedure in 2000 cases from the same clinic. In 1926 Deutschman reiterated the original purposes and technique and added further cases.

In 1927 Harrar reported 5800 cases from both the indoor and outdoor services at the Lying-In Hospital in New York and said, "By this we do not claim painless childbirth, but it gives relief to the agonizing part of the ordeal of labor." This statement represented the views of those who had had the greatest experience with the method. The views of Gwathmey and his associates may be summarized by stating that they found all the drugs used at the proper time and in the prescribed dosage were safe to both mother and child. These authors write that:

> While analgesia is the fundamental factor in this method, anmesia is also frequently present; that 90 per cent of patients obtain some relief, the greater percentage a great deal; that it may be used as easily in the home as in the hospital; that it is inexpensive and does not require an especially trained person to administer it; and that the obstetrician does not have to be present continually throughout labor. It does not prolong labor even in cases of bad positions and presentations. Vomiting is not more frequent than without the analgesia. The perineal muscles are well relaxed; patients are quieter and undergo less strain, consequently are in better condition the next day. A small percentage of patients showed excitement, but not to the extent of requiring forcible restraint. The only contraindications are colitis, diabetes, and auditory disturbances. It is not contraindicated in cardiac cases, toxaemia or placenta praevia that have been permitted to go into labor; asphyxia, postpartum hemorrhage, and stillbirths are not more frequent than if this method had not been used.

Beckman in 1925 in carefully controlled animal experiments and in an equally carefully presented paper, questioned seriously the synergistic properties of the drugs and questioned the advisability of using the magnesium sulphate. In 1930 despite the attack of Beckman, Gwathmey published the results of 20,000 additional cases, bringing the total cases of himself and co-workers to about 30,000. Hatcher in a definitive and inclusive article gives the following investigators consideration in his paper as having tried Gwathmey analgesia and reporting its use with varying results, mostly favorable: Hunt, Wallbillich, Chrounch, Randall, Spangler, Moore, Guess, Poliakoff, Lewis, Loerincz, Finger, Hadjicakis, Martin and Jackle, Schiffman and Seyfert, and Vogt, Gwathmey and his co-workers.

In 1931 Stevens, then Burrows, then McCormick, published their case reports. McCormick suggested certain modifications and submitted an apparatus designated to simplify the giving of the colonic ether-oil instillation which has met with acceptance and is quite efficient.

With the opening of this clinic in September, 1932, there arose the question of the type of analgesia to be used in the conduct of labor exclusive of the second stage, during which time nitrous-oxide oxygen is employed. The original technique of Gwathmey was considered since it had its inception at the New York Lying-In

Hospital, which service is continued here. It was discovered that for the past several years many of the men formerly subscribing to the Gwathmey technique had abandoned certain features of it and were now using a modified technique. This modification consisted of the use of morphine and scopolamine followed by rectal ether-oil instillation. Harrar and later Jellinghaus, Wing, Williamson and Steele employed this in their private practice as did other members of the Lying-In Hospital staff. Hence, this modification of technique was incorporated as the routine procedure for patients who were to receive rectal analgesia and is the technique as used in the patients reported in this study.

TECHNIQUE OF ADMINISTRATION

The technique of administration of the rectal analgesia is given here, taken verbatim from our clinic routine. Preliminary medication in the sequence of the analgesia is kept in the medicine cupboard and is verified by the nurse in charge of the delivery floor before being given. There is always set up for use a tray for rectal analgesia consisting of the following:

1. McCormick apparatus with tubing and glass connecting tip.
2. Two sterile V-pads in package.
3. Package of sterile 4 × 4 gauze sponges.
4. Jar of vaseline.
5. White enamel basin containing two French catheters, No. 22.
6. Round white enamel basin.
7. Flask of olive oil.
8. Medicine glass.
9. Four bottles of retention enema solution:
   Two, No. 1 containing:
   Quinine hydrobromide gr. (1.2 gm.)
   Ether ounces 2½ (72 c.c.)
   Alcohol m. 45
   Liquid petrolatum ad ounces iv (120 c.c.)
   One, No. 2 with quinine gr. (0.6 gm.)
   One, No. 3 without quinine or alcohol.
10. One small treatment rubber with cover.

At the beginning the obstetrician should explain to the patient that her steady cooperation in trying to retain the instillation will result in the relief of pain and that she will fall asleep and likely not waken until after the baby is born. Success depends considerably upon cooperation and confidence.

When the patient is first seen she is examined rectally to determine the progress of labor. If early in labor, she is considered a candidate for the standard procedure; or, if labor has progressed further as indicated by a 6–7 cm. dilatation of the cervix, we give only the rectal instillations. The standard procedure is as follows:

The perineum is prepared in the admission bath room. The patient, if in labor, is then brought to the labor room on the delivery floor. If her pains are not too strong a cleansing soap-suds enema is given. In primigravida, when the pains are well established, coming at five minute intervals and lasting thirty to fifty seconds, and the cervix is 3–4 cm. dilated, a hypodermic injection of morphine sulphate .010 gm. and scopolamine .0003 gm., is given. The patient is advised to remain quiet, the room is darkened. All manipulations are gently and quietly done, and talk is in whispers; the patient, if talkative, is not answered. This hypodermic injection of morphine and scopolamine is not given to multiparae.

The ether mixture, already prepared and sealed, is kept warm in a dish of warm water. The apparatus used for the instillation is that designed by C. O. McCormick. The directions for the use of the apparatus are concretely stated on the plate. The patient is turned on her side with knees partly flexed and the area surrounding the anus is smeared with vaseline to assure

no irritation should the instillation be expelled. The gloved right index finger covered with vaseline is inserted into the rectum and the lubricated French catheter, connected to the apparatus, is followed along this for 8 inches or more, to insure its being inserted above the presenting part, otherwise, if the catheter curls up, the instillation will be expelled. This is an important point in the technique. The ether-oil solution is placed in the apparatus, which has previously been supplied with 30 c.c. of olive oil. The gloved finger is removed, the cock opened, and the catheter is held in place by the left hand. With the right hand the bulb is compressed, between pains only, not over 20–30 times per minute. Just as the bubble passes through the sight-feed compression is stopped, the cock is closed. The catheter is then removed and a folded towel is held over the anus for ten to fifteen minutes. This is one of the most important features on which the success of the analgesia depends. The patient is then quietly turned on her back (for frequently the patient has gone to sleep during the instillation) and she is kept warm with blankets.

The results of the medication vary from a sedative effect to analgesia with unconsciousness and complete amnesia. While the instillation proceeds and often before the whole instillation is given, she falls asleep. Labor progresses, the contractions ensue, sometimes accompanied by slight murmuring and slight restlessness at the height of the contraction. Often she remembers nothing from the time of the instillation until she awakens in the pavilion after the delivery is over. After instillation relief is obtained for varying lengths of time according to the patient's nervous make-up, the progress of the labor, and the ability of the nurse. Freedom from complaints of pain is usually from three to six hours. The instillation may be repeated, if necessary, at intervals of three hours or more, two, three, four or five times with safety, the subsequent instillations being Numbers 2 and 3 or preferably number 3 of the foregoing formulae. The morphine and scopolamine are, of course, never repeated in order to avoid the possibility of fetal asphyxia. This is emphatically explained to the nurse. The progress of the labor is followed by routine rectal examinations by the house officer beginning preferably after about twenty or thirty minutes to avoid stimulation or expulsion and disturbances. On moving the patient on to the stretcher she should be lifted, her eyes should be protected against strong electric lights and the same quiet stillness maintained during her preparation and delivery. Most of these patients are given gas-oxygen for the second stage, a minimum amount being required, but frequently no inhalation anesthesia is required and occasionally perineal repair has been effected without additional anesthesia.

The multiparae are given rectal instillations only and do not receive the hypodermic medication; as their labors are usually so much shorter that the instillation carries them adequately.

ANALYSIS OF CASES

This series comprises 400 patients who were treated by the foregoing procedure.

TABLE 1
PARITY AND AGE INCIDENCE

Patients	*With Rect. Anal.*	*Without Rect. Analgesia*	*Age Groups (Years)*	*With Rect. Anal.*	*Without Rect. Anal.*
Primigravida ...	295	295	15–20	39	49
Multipara.....	105	105	20–30	284	268
			30 and over	77	83

A similar number of cases of the routine clinic population, not receiving rectal analgesia, were used as controls. These controls were selected consecutively and the figures only were studied by the writer as he had nothing to do with their selection,

thus minimizing the objection to "selection" of cases.

From Table I it may be seen that there is an equal number of primiparous and multiparous patients and that the age groups vary only slightly.

TABLE II
NORMAL PREGNANCY AND COMPLICATIONS

Cases	*Receiving Rectal Analgesia*		*Not Receiving Rect. Anal.*	
Types	*Number*	*Per Cent*	*Number*	*Per Cent*
Normal	331	82.7	340	85.0
Low reserve kidney	40	10.0	21	5.2
Chronic nephritis	3	0.7	6	1.5
Pre. ect. and eclampsia	5	1.2	5	1.2
Unclassified	5	1.2	0	0.0
Others	16	4.0	28	7.0

In Table II we considered any type of toxemia or other complication which was present in any of the routine clinic cases as compared with those receiving rectal analgesia. It may be seen that there is included the different type of toxemia of pregnancy, the titles being self-explanatory except the title "Others," under which are included: elderly primiparae, syphilis, antepartum bleeding, anemias, bronchitis, pneumonia, cardiac disease and the patients with tuberculosis. The percentage of normal pregnancies was slightly higher in the cases not receiving rectal analgesia. These abnormalities, of course, represent antepartum diagnoses.

In Table III we considered and indexed the type of pelves occurring in both groups of patients studied. The classification used was the indexing system in use at the New York Hospital. From Table III we note that there was 90.0 per cent normal pelves in the cases not receiving rectal analgesia contrasted with 83.2 per cent normal in the cases receiving it. This might be interpreted as being a real obstacle to be overcome in a favorable summation of results obtained by the procedure under question; due to the tendency of contracted pelves toward prolonged labors.

TABLE III
TYPE OF PELVIS

Patients	*Receiving Rect. Anal.*		*Not Receiving Rect. Anal.*	
Type	*Number*	*Per Cent*	*Number*	*Per Cent*
Normal	333	83.2	361	90.2
G.C. typical	17	4.2	7	1.7
G.C. funnel	11	2.7	3	0.7
Flat	13	3.2	4	1.0
Flat funnel	2	0.5	1	0.2
Funnel typical	24	6.0	24	6.0

In Table IV the type of delivery is studied, "operative" refers to all types of forceps deliveries in vertex presentations; the breech figures include both operative and spontaneous. An evaluation of this table is clear. There were more spontaneous deliveries in cases where rectal analgesia was used despite the 8 per cent more contracted pelves noted in Table III. Also, contrary to the impression of many, there were not more but actually less forceps deliveries in these receiving rectal analgesia than in the control series. The difference was not large but is significant, since the impression to the contrary is often expressed without basis.

TABLE IV
MODE OE DELIVERY

Cases	*Receiving Rect. Anal.*		*Not Receiving Rect. Anal.*	
Type	*Number*	*Per Cent*	*Number*	*Per Cent*
Spontaneous	300	75.0	294	73.5
Operative (forceps)	83	20.7	86	21.5
Breech	17	4.2	20	5.0

TABLE V
POSTPARTUM HEMORRHAGE

Cases	Receiving Rect. Anal.		Not Receiving Rect. Anal.	
Type	Number	Per Cent	Number	Per Cent
Normal 3rd stage	393	98.3	388	97.0
P.P. hemorrhage (600 cc. or over)	7	1.7	12	3.0

In Table v we present the figures on postpartum hemorrhage. We index as "Postpartum Hemorrhage" any loss of blood at delivery amounting to 600 c.c. or over. From this table it will be noted that there is a remarkable and sizeable difference in the occurrence of postpartum hemorrhage. Why this should be is indeed an interesting problem and worthy of note.

TABLE VI
CONDITION OF CHILD

Cases	Receiving Rect. Anal.		Not Receiving Rect. Anal.	
Results	Number	Per Cent	Number	Per Cent
Good	374	93.5	370	92.5
Resuscitated	16	4.0	13	3.2
Stillbirths and neonatal deaths	10	2.5	17	4.2

In Table vi we have recorded the condition of the child from three aspects. First, normal infants, crying, good color, requiring no stimulation; next, resuscitated babies, either requiring artificial respiration, hot and cold tubs or the use of the Flagg apparatus; lastly, stillbirths or neonatal deaths, which includes up to the fourteenth day of life. In this presentation of the condition of the child we believe we have precluded any chance of misconstruction of the results. In this table we note that here there is also a striking difference in the results. Of the total number of stillbirths in the group receiving rectal analgesia there were 3 in whom no cause of death could be elicited, while in the control group there were 6 such deaths, a difference of 50 per cent. This is certainly a positive factor in evaluating the results of rectal analgesia. We may then state that in our series of cases that stillbirth and neonatal death rate is not increased but actually decreased in the group receiving rectal analgesia.

TABLE VII
PUERPERAL MORBIDITY

Cases	Receiving Rectal Anal.		Not Receiving Rect. Anal.	
Results	Number	Per Cent	Number	Per Cent
Afebrile	305	76.2	300	75.0
Mastitis	24	6.0	10	2.5
Pyelitis	3	0.7	3	0.7
Puer. inf.	41	10.2	37	9.2
One day fever	27	6.7	50	12.5

In this clinic we take the temperatures every four hours and more often if the patient's course suggests it. From Table VII it may be seen that there were actually more patients who had a normal afebrile puerperium in the group receiving rectal analgesia than in the control group. However, the incidence of puerperal infection was higher in the patients receiving rectal analgesia than in the control group by a small figure. The figure is not large and no higher than might occur in any two routine clinic series reported at any time. In the patients receiving rectal analgesia there was 76.2 per cent with normal afebrile puerpera compared with 75.0 per cent in the control group. Puerperal infection was 10.2 per cent in the analgesia cases compared with 9.2 per cent in the control group. Noteworthy are the figures on "one day fever," meaning a single rise to 38.°c. after the first twenty-four hours postpartum; for in the analgesia patients

there were 6.7 per cent in this category compared with 12.5 per cent in the control series, a difference of 23 patients. This certainly should offset the small percentage of puerperal infection against the group receiving rectal analgesia.

Table VIII
DURATION OF TOTAL LABOR

Cases	*Receiving Rectal Anal.*		*Not Receiving Rect. Anal.*	
Results	*Number*	*Per Cent*	*Number*	*Per Cent*
Normal.....	352	88	358	89.5
Prolonged.....	48	12	42	10.5

We index as prolonged labor any labor that exceeds thirty hours in total duration. From Table VIII it will be noted that there are six more instances of prolonged labor in the group receiving rectal analgesia than in the control group, a difference of 1.5 per cent. Here we refer to Table III which shows 28 more contracted pelves than were found in the control group. We might even say that in this series rectal analgesia certainly did not prolong labor, but tended to reduce the length of labor and possibly reduced the incidence of prolonged labor from a higher figure to a small 1.5 per cent when it might well have been at least 7 per cent judging from the cases presented in Table III.

Table IX
DURATION OF SECOND STAGE OF LABOR

Cases	*Receiving Rectal Anal.*		*Not Receiving Rect. Anal.*	
Results	*Number*	*Per Cent*	*Number*	*Per Cent*
Normal.....	322	80.5	320	80.0
Prolonged.....	78	19.5	80	20.0

The figures under prolonged second stage were compiled in adherence to our indexing system in this clinic. We index as prolonged second stage any second stage that is or exceeds two hours. Some obstetricians feel that rectal analgesia has a tendency to prolong the second stage; but figures in Table IX show that this is not the case. There are actually more cases with prolonged second stage in the control group than in the group receiving the rectal analgesia. This difference is not large, .5 per cent, or 2 cases, and hence we do not consider it to be of great value, except that it counteracts the criticism often launched against rectal analgesia, namely, that it prolongs the second stage.

Table X
PATIENTS RECEIVING MEDICATION

Cases	*Number*	*Per Cent*
Standard procedure.....	244	61
Rectal instillation only.....	156	39

In Table X we have listed the patients as to the form of treatment they received. The standard procedure, of course, embraces the primigravida, while the second group who received only the rectal instillations is comprised chiefly of multiparae and some primigravidae seen too late in labor for the hypodermic injection to be given. Sixty-one per cent of the patients received the standard procedure and 39 per cent received the instillations only.

Table XI
ANALGESIA INDUCED

Cases	*Number*	*Per Cent*
Poor or expelled.....	13	3.2
Fair.....	50	12.5
Good and excellent.....	337	84.2

In presenting the figures in Table XI we realize that it is unsatisfactory to estimate and especially to list the effect of any agent on pain; but in this particular series we have felt that the patient's own

impression was one of the most satisfactory criteria as to the efficacy of the analgesia. This statement from the patient we were able to get in over 60 per cent of the patients. However, both the patient's statement and the manifestations observed were taken into consideration. In the first group "poor or expelled" were placed all patients that received no sedative or analgesic effect, or that expelled the instillation. In the next group, "fair," we placed patients that received some relief from their pains but still felt them, the analgesic being imperfect or of short duration. The last group, "good and excellent," contains the patients who received great relief both during and between their contractions. The majority of these were either conscious, feeling simply cramp-like sensations at the height of the contraction, or were unconscious and had practically no pain following the medication except when the head distended the perineum. Furthermore, each of the patients who are included in this group, that we consulted, answered in the affirmative when asked whether they would rather have the analgesia with their next baby. In Group 1, "poor or expelled," the percentage was 3.2 per cent. In Group 2, "fair," the percentage was 12.5 per cent, while in Group 3, "good and excellent," the total percentage was 84.2 per cent.

As an illustration the history of a typical patient receiving excellent results is given:

Mrs. R. G. No. 640. Gravida 1, para 0. Estimated date of confinement: November 19, 1932.

History of labor at time of admission: Contractions began at 3:30 A.M., November 16. Membranes apparently ruptured. Admitted to hospital November 16, at 3:45 A.M. Examination showed the fetal heart to be 128 beats per minute; contractions occurring every seven minutes, and the cervix 1–2 cm. dilated. She continued having irregular pains until the morning.

7:55 A.M. Rectal examination. Cervix 2–3 cm. dilated.

8:00 A.M. Given morphine .010 gm., scopolamine .0003 gm. (hypodermically).

10:00 A.M. Contractions good, every four to six minutes. The fetal heart was about 132–140 per minute. The patient was drowsy and sleeping at intervals.

1:30 P.M. Rectal examination. Cervix thinning and 4 cm. dilated. The fetal heart was still about 132–140 beats per minute.

1:45 P.M. Ether retention enema No. 2, retained.

2:00 P.M. Patient did not complain of pain, sang Italian songs, became slightly restless at height of the contractions. Contractions continued good quality, well sustained, occurring every three to five minutes. Fetal heat 132–140 beats per minute.

3:45 P.M. Increased show. Second stage pains every one to three minutes. Rectal examination showed cervix fully dilated.

3:50 P.M. The patient was transferred to the delivery room. The fetal heart was 144 beats per minute. Nitrous oxide analgesia given with contractions.

4:00 P.M. The caput was seen.

4:24 P.M. Normal delivery. Nitrous oxide analgesia. No laceration. Baby cried immediately.

4:35 P.M. Placenta separated spontaneously and was expressed from the vagina. Blood loss 250 c.c.

The patient was questioned on the pavilion: Patient felt that the hypodermic took "pains away." She did not remember having the retention enema, except being told to breathe with her mouth open. She had no recollection of pain or being transferred to delivery room. Everything was vague and indefinite until after delivery.

Impression: Excellent analgesia.

Elapsed time from Morphine and Scopolamine to delivery eight hours twenty minutes.

Morphine and scopolamine relieved about six hours.

The ether retention enema relieved the remaining two hours and twenty minutes supplementing the original medication.

It is interesting to note that in no patient receiving the rectal instillation was there any clinical symptom or sign of irritation of the rectum or sigmoid during labor or the puerperium. Furthermore, there was no instance of pneumonia or suggestion that these patients had any respiratory tract infections.

SUMMARY

1. Rectal analgesia may be used in all normal obstetrical patients as well as those with dystocia or suffering from such complications as toxemia, cardiac disease, placenta previa, or other abnormalities.

2. Only in cases of severe colitis, a fistula or an ischiorectal abscess is this method of analgesia interdicted. Extensive hemorrhoids without abrasions are not affected and do not contraindicate this method.

3. We recommend the employment of a certain standard of administration of the analgesia with references to the progress of labor as outlined; although McCormick has shown and advised that after the preliminary hypodermic the patient's complaints may be safely substituted for the dilatation of the cervix in judging when to administer the instillation.

4. There is no increase in the occurrence of postpartum hemorrhage; in this series of rectal analgesia it was actually less (Table v).

5. The stillbirth and neonatal death rate was less by a sizeable figure in this series of cases receiving rectal analgesia than in the control group (Table vi).

6. The morbidity was higher in the control cases than in the cases receiving analgesia, although there was a 1 per cent higher occurrence of puerperal infection in the cases receiving the rectal analgesia (Table vii).

7. Labor is not prolonged. Though there were 6 more cases of prolonged labor in the group that received rectal analgesia; it is to be noted that there were also 28 more contracted pelves in this group which may offset this small percentage (1.5 per cent) of prolonged labor. (Table viii.)

8. The second stage is not prolonged. Actually in this series the patients with rectal analgesia had a slight shortening of the second stage of labor (Table ix).

9. Spontaneous deliveries were higher, by a small percentage, in the cases that received rectal analgesia, operative deliveries being higher in the control series.

10. Excellent results in analgesia were obtained in 84.2 per cent of the patients receiving it; 12.5 per cent received some relief and only 3.2 per cent received no relief. (Table xi.)

11. There were no rectal complications noted in any of the patients receiving rectal analgesia.

12. In our series there were only 4 per cent of the patients that showed excitement, and only one patient in the entire series was excited to the extent of requiring restraint.

13. The word of the patient after delivery is one of the best criteria as to the worth of an analgesic agent, and according to this standard rectal analgesia rates exceedingly high as shown in the foregoing figures.

14. While this series should not be considered as attempting to prove that this form of analgesia is recommended for universal use and regarded absolutely effective in all respects, it seems conservative to conclude that in our series the hypodermic injection of morphine-scopolamine and the instillation of rectal ether-oil had a definite sedative action on the pains of labor without in any way increasing the fetal or maternal mortality rates.

15. It appears to us that this form of analgesia is a simple, effective and apparently harmless method of obstetrical analgesia. No evidence of colitis or respiratory tract infections was noted.

16. It must be impressed upon those now using rectal analgesia or considering its employment that results improve as technique becomes more perfected.

17. There is no increase in the vomiting noted during labor in the patients receiving rectal analgesia.

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[For Remainder of References see p. 301.]

PILONIDAL SINUS*

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THE condition most frequently designated as a pilonidal sinus or cyst has been described under various other terms, the more usual ones being sacral dermoid and sacrococcygeal sinus or cyst. Hodges, in 1880, is credited with the name pilonidal sinus, meaning a nest of hair. However, it is not always descriptive, as hair is not always found, and it would seem that sacrococcygeal sinus might be the better term as it both locates and describes the condition, the objection being that there is no connection with either the sacrum or the coccyx. It is probably best that we continue the former designation since it is so much more commonly used, in this country at least.

In view of the fact that many patients have had considerable treatment without permanent cure, one suspects that the diagnosis is frequently overlooked, or that the pathology is not clearly understood. For this reason, and because it is an extremely interesting condition, this paper is presented to outline briefly the theories of the etiology, to review the pathology, to present certain diagnostic data, and to consider the proper treatment.

ETIOLOGY

There are several theories as to the etiology. Warren, in 1867, first described the condition and expressed the belief that it might be due to a reversed hair follicle. Mallory and many others advocate the theory that it originates from remnants of the medullary canal, that is, that there has not been a complete obliteration of the lower end as it is formed from the ectoderm. Stone has recently advocated one of the most interesting theories, at least from the standpoint of evolution. He has suggested that it is a vestigial structure analogous to the preen or oil glands of birds. Others, including Bland-Sutton, believe that it is due to inclusion of normal epithelium in the tissue because of a faulty coalescence in fetal life, a true sequestration dermoid being thus formed. Another theory is that it is caused by traction of underlying tissue on the median raphe, resulting in, as Newell suggests, a traction dermoid. Not infrequently midline dimples are seen without a true sinus being present, which suggests the traction of underlying tissue is perhaps that cause of the dimple. It would be extremely interesting, and perhaps would prove the origin of the condition, if a series of infants who have midline dimples could be followed into adult life. In that way it could be ascertained whether or not the dimple was changed and pulled into a true sinus as the body enlarged.

PATHOLOGY

Anatomically, an uninfected pilonidal sinus consists of an orifice in the sacrococcygeal region, leading upwards over the sacrum from 1 to 5 cm. and ending in a bulbous blind pouch. The orifice is small, usually round, and will admit a small probe. The entire sinus is lined with true skin, containing the usual glands and hair follicles. A tuft of hair frequently protrudes from the orifice, and hair and detritus may be found in the bulbous end. From a surgical standpoint, the condition is rarely observed before infection has taken place. It is thought that the usual sequence of events is the plugging of the opening with hair, sebaceous material and detritus, maceration of the lining epithelium, and

* Read before The Los Angeles Surgical Society.

entrance of organisms into the surrounding tissues. Trauma may frequently be an exciting cause, a definite history being elicited in 20 per cent of the cases in this series. The infection travels along the lines of least resistance, usually upwards and laterally, causing the customary picture that is seen by the surgeon.

The patient complains of a boil, or more frequently of a series of boils, that have formed, ruptured or have been incised, after which the area may be healed for weeks or months, only to break out in a new location. Some of the boils may not be entirely healed, leaving small openings which exude a few drops of pus. On examination the midline dimple is seen with an indurated area above, surrounded by one or more sinuses, and the scars of healed sinuses. The infection may be pointing in a new location, with the usual signs of redness, tenderness, swelling, induration or fluctuation. However, the most important fact to know is that the innermost wall of the bulbous end of the sinus lies in close proximity to the fascia covering the sacrum. If this is kept in mind, a cure will be obtained in the majority of cases.

DIAGNOSTIC DATA

From a clinical standpoint, there are certain data that are helpful in diagnosis. This series of 40 cases is from my private practice and from the Los Angeles General Hospital.

The condition appears chiefly in early adult life and predominately in males. In this series the majority were between eighteen and twenty-eight years of age, the youngest being three and the oldest forty-three. Masson reports a case in an infant nineteen months old, the oldest patient in his series being fifty-seven years old. Of the patients in this group, 66 per cent were males, in Stone's series 84 per cent, and in others from 66 to 80 per cent. There was one Negro, although pilonidal sinus rarely occurs in the Negro race. Stone did not have any Negro patients in his series, although the percentage of Negroes in Baltimore is large.

The average duration of symptoms before operation was three and a half years, the shortest four months, and the longest fifteen years. It is interesting to note that in the private cases the average duration of symptoms was approximately one year.

Sixteen patients had had previous medical attention, either minor operations, consisting of the lancing of so-called boils, poultices, or curretting of the sinuses. Five, or approximately 12 per cent, had had attempts at complete excision.

There seems to be a familial tendency, as it occurs with enough frequency to make it more than coincidental. I operated on a brother and his sister; one other patient told me that his brother had the same condition, and another that his father had been operated upon for a pilonidal sinus several years previously.

There are certain other pathological conditions which may be found in the same location, but the picture as previously described will usually confirm the diagnosis. Fistula in ano can be differentiated by probing the sinus and by rectal examination. Osteomyelitis can be ruled out by *x*-ray or the fact that the probe inserted into the sinus will not be felt to come into direct contact with the bone. True dermoids may occur in this region, but in all probability could scarcely be differentiated even by excision, and such differentiation would be of no practical importance.

TREATMENT

As to treatment, radical elliptical excision of the entire area down to the fascia covering the sacrum is the method of choice. In order to carry out this radical excision, elliptical incisions are made on either side of the area, approximately ½ inch outside the most lateral sinuses. The incisions are carried downwards and towards the midline to the fascia covering the sacrum, and the entire mass of tissue is stripped from the fascia, thus leaving

a defect with beveled edges. It is my opinion that we too frequently are not willing to sacrifice enough of the superficial tissue to bevel the edges properly. This may result in healing with a sinus leading to the depth of the wound which will heal slowly, if at all. Care must be taken that all of the sinuses are excised and that the fascia is stripped clean.

Many advocate the injection of the tracts with methylene blue, melted paraffin, or lipiodol followed by roentgenograms, but I rarely use these procedures, for it is usually easy to be certain that the incisions are carried into healthy tissue on each side, and the depth of the excision is always the same. As a rule any accessory tract that is cut across may be seen and the incision carried around its lateral extension. There are two further objections to the use of injected fluids. In the first place, the fluid may be forced out into healthy tissue with comparative ease, and secondly, the injection gives one a false sense of security for all the ramifying tracts may not be injected and therefore will frequently not be excised. Involvement of the fascia covering the sacrum, and the sacrum itself, has not been observed in this series of cases, although instances of such involvement have been reported and the possibility should be constantly borne in mind.

Others have suggested a narrower excision, with undercutting of the skin, but this does not seem to hasten healing, and may lead to pocketing, with greatly delayed recovery. Lahey has suggested the use of a pedicle graft from the better side, in order that the scar may not be in the midline. The midline scar does not seem to be objectionable, however, and there is probably some danger of delayed healing under the pedicle graft.

In the majority of cases attempts at primary closure are not advisable. If the area is large, it is difficult and often impossible to obtain enough relaxation to allow closure without undue tension. Hospitalization is prolonged, and the period of disability is not materially shortened. To be sure, healing takes place slowly without primary closure, in some instances requiring as long as four to six months, but usually from eight to ten weeks only. However, the patient need not be disabled for the greater portion of this period nor greatly inconvenienced during this time. In the minority of instances, where the sinus is not infected or where the secondary sinuses are either in or just lateral to the midline, it is my opinion that primary closure may be attempted and will usually be successful.

The after-treatment is important. If the wound is allowed to remain open after excision, it should be loosely packed with vaseline gauze until it is certain that no pocketing can occur. The formation of healthy granulations may be stimulated by hot compresses, hot sitz baths, balsam of Peru, and so forth, but the frequent application of strong antiseptics is to be condemned, as the resulting scar has a tendency to be firm, non-pliable and tender. Because of the location of the wound epithelization is obtained with some difficulty, and the last stages of healing proceed with exasperating slowness.

In the more simple case, I would suggest the use of a conservative type of treatment before surgery is advised. Some months ago, Cutler and Zollinger suggested the use of a modified Carney's solution as a sclerosing fluid, and reported its use in branchial, thyroglossal, and pilonidal sinuses. I have used this method in 3 instances, in two the patients have been entirely well for six months, and in the third for one month. Even six months is too short a period to be certain of a cure, and it is probably best to withhold final judgment until a larger series have been treated over a considerable period of time. Under local anesthesia the midline orifice is enlarged sufficiently to allow the removal of all hair and detritus. The surrounding skin is protected with vaseline or zinc oxide ointment and the sinus filled with the solution. This is allowed to remain about

ten minutes and then removed. The cavity is packed loosely with a strip of gauze and the procedure repeated on three or four occasions, with an intervening day or two. Each time the cavity is gently curretted and when it is thought that healthy granulations are forming it is allowed to heal. Accessory sinuses are also injected, it being my experience that usually only one injection is necessary to obtain healing of such sinuses. It is surprising that this treatment is not accompanied by more distress and inflammatory reaction. The advantages are that the patient is not disabled, other attempts at cure can be carried out later if the result is not satisfactory, or if necessary, one may resort to surgery. There are possibly some dangers, although they would seem remote. I would hesitate to carry out such a procedure unless the diagnosis was obvious. Cases of involvement of the bone have been reported, but the injection of the sclerosing fluid into a sinus leading into bone would not appear to offer serious complications.

SUMMARY

1. The various theories concerning the etiology of pilonidal cyst are briefly outlined.

2. The cyst consists of an orifice ending in a blind pouch, lined with true skin containing glands and hair follicles. It is rarely seen before infection has taken place.

3. The disease is one of adults, apparently with a familial tendency. Symptoms average three and one-half years' duration.

4. In closing, may I again stress the adequate excision of the entire area, the advisability of making no attempt at closure in the majority of cases, and suggest the use of the sclerosing fluid in the less complicated case, or in the patient for whom surgical procedures are contraindicated.

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* Continued from p. 297.

THE LOCAL TREATMENT OF WOUNDS*

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BY the "Local Treatment of Wounds" is meant treatment as applied directly to tissues, the continuity of which has been severed. General treatment such as the administration of blood, fluids, chlorides, foods, vaccines and antitoxins will not be discussed. The influence of disease states such as anemia and diabetes will purposely be omitted. Even with these limitations the subject is large and must necessarily be confined to the principles of treatment without reference to specific locations of wounds. Special considerations enter into the treatment of wounds of the eye, brain, pleura, heart, peritoneum, urinary bladder, joints and other important structures which makes of each one a subject in itself. The principles underlying the treatment of wounds are the same, however, regardless of their extent or location.

Before studying the treatment of wounds it is proper to inquire into their methods of healing. How do wounds heal? What agencies or factors facilitate this process and which ones retard it? Most pathologists and surgeons speak of wounds as healing by first and second intention. The two processes are essentially the same. By first intention is meant the prompt healing of a wound with very little inflammatory reaction, the reaction being so small that there is no redness and no grossly appreciable swelling of the wound and no secretion from it other than clear serum or normal blood within the first few hours.

Healing by second intention is the same process to which is added the phenomena of inflammation. Inflammation is due to some injury to the tissues and causes a delay in the healing process. The amount of delay depends upon the severity of the injury and the ability of the body to overcome it. Once the irritant is removed by the inflammatory process healing rapidly progresses. Since healing is due to an actual growth of cells anything which prevents the approximation of tissues during the healing process and disturbs that process once it is started will delay healing. To obtain prompt healing, or in other words healing by first intention, we must exclude from wounds any factor which prevents approximation and any injurious substance. Substances injurious to wounds may be divided into bacterial, mechanical, physical, and chemical.

The importance of excluding bacteria from wounds is now generally recognized and the various methods of exclusion will not be described. Attention is called however to the recent work of Dandy and of Meleney. Dandy emphasized the importance of adequate sterilizations of supplies. He has proved that a constant minimum pressure of 20 pounds for at least one hour is necessary to kill bacteria by autoclaving. Meleney found that members of the operating room personnel sometimes carried streptococci in their noses and throats which lead to serious postoperative infections. He reduced the incidence of such infections by covering the nose and mouth of every person entering the operating room. Routinely now when postoperative infections occur he makes cultures of the noses and throats of the entire surgical staff to discover if carriers are present.

* Delivered before the Davies County Medical Society, Owensboro, Ky., before the Louisville Surgical Society at Louisville, Ky. and before the Logan County Medical Society at Russellville, Ky.

That the natural protective forces of the body can overcome bacteria in wounds has been demonstrated both clinically and experimentally. Halsted showed that the presence of necrotic tissue or foreign bodies in wounds greatly enhanced the ability of bacteria to multiply sufficiently to cause infection. He opened the peritoneal cavity of thirteen dogs and introduced cultures of Staphylococcus aureus. None of the dogs developed peritonitis. In nine dogs "a small piece of potato covered with a thick growth of Staphylococcus aureus was introduced into the peritoneal cavity. All of the dogs died of general peritonitis." In five dogs "a small piece of sterilized potato was introduced into the peritoneal cavity. Peritonitis did not develop in a single case." In eight dogs "a small piece of omentum was ligated with strong silk. The ligature and the tied-off portion of the omentum were inoculated with a drop or two of a bouillon culture of Staphylococcus aureus. There was a fatal peritonitis in two cases and circumscribed peritonitis in two cases. Four of the dogs recovered without peritonitis."

The obvious deduction from these experiments was that the natural resources of the body were able to overcome virulent bacteria as long as there was no necrotic tissue or greatly injured tissue present. Given the presence of necrotic tissue either in the form of a strangulated piece of omentum or a piece of potato the bacteria were able to overcome the body resistance and cause a fatal peritonitis. The commonest cause of necrotic tissue in wounds is suturing with tension and ligating of large masses of tissue. These cause necrosis by depriving tissues of their blood supply. Halsted also frequently called attention to the fact that in pre-antiseptic days subcutaneous operations usually resulted in primary healing though the instruments employed were almost invariably contaminated with virulent organisms. The knives used, however, were sharp and there were no strangulating ligatures or sutures and no rough handling of tissues. Some blood was present of course but it was not under tension and seldom gave trouble.

In treating wounds injurious factors of mechanical nature are clamping tissues, ligating masses of tissues, leaving foreign bodies, taking unnecessarily large bites in suturing, suturing under tension, rough handling of tissues, rough sponging, strenuous retracting, and applying tight dressings. The teaching of James Paget that "wounds should not be rubbed even with sponges" is still true. Injurious agencies of a physical nature are excessive heat or cold and dehydration. Injurious chemical substances include most drugs, particularly antiseptics. Some of these agencies act by constricting the blood supply sufficiently to lead to necrosis while the others cause death of the cells by direct physical and chemical changes.

Accurate approximation of wound edges is essential for prompt healing. It is also important to exclude from the line of union tissues which do not properly belong there. This is especially true of fat as it heals poorly and readily becomes necrotic. To obtain approximation sutures are necessary. The ideal suture material is one that will strongly support and approximate the tissues, cause no inflammatory reaction, and when healing is complete, disappear. Unfortunately such a suture has never been found. The two great varieties of sutures are the absorbable and the non-absorbable. The most commonly used absorbable suture is catgut while silk is the most popular non-absorbable suture. The absorbability of catgut is its only virtue when compared with silk. It is difficult to sterilize; wounds sutured with it are not as strong as those made with silk; it often absorbs too soon; it excites a greater reaction in the wound and it promotes infection to a greater degree than does silk.

Being an animal tissue which is easily injured by heat or chemicals and being derived from a grossly infected source makes difficult the sterilization of catgut.

Many cases of postoperative tetanus and gas gangrene directly traceable to its use in the operation have been reported. Some

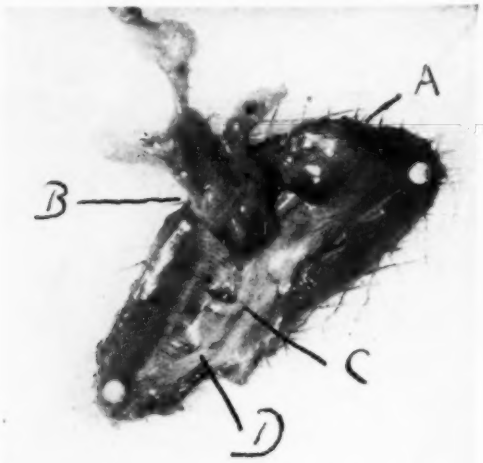

Fig. 1. Two catgut sutures (00 chromic) and two silk sutures (A black) were placed in abdominal muscles of guinea pig. Four days later pig was killed and section of wall removed. Illustration is of peritoneal surface of sutured muscle showing four sutures having worked toward peritoneum. A, reaction around first catgut suture. B, adherent omentum to second catgut suture. C and D, silk sutures with practically no reaction around them.

of these have resulted fatally. In 1931, Meleney and Chatfield reported: "In a recent study of 174 specimens of catgut sent us by twelve different surgical clinics, scattered throughout the country and either taken from their stocked supply or purchased from the open market, twenty-two, or 12½ per cent, were found to yield spore-forming bacteria, including the common gas gangrene organisms." Almost certainly there have been many similar infections from catgut which have not been reported. That more have not developed speaks well for the resisting powers of the average human body.

That wounds sutured with catgut are not as strong as those sutured with silk has been experimentally demonstrated by Dr. E. L. Howes of New York. He studied the strength of wounds made in the gastric and abdominal walls and sutured with catgut and silk. Of wounds made in abdominal walls "the results showed that in every instance the wounds sutured with silk were stronger than those sutured with catgut. Besides, in two of the wounds sutured with catgut separation of the peritoneum had occurred, yet these

Fig. 2. Proper method of treating avulsed flaps. Picture taken one week after highway accident showing living flap and wound free from inflammation. Had wound been completely closed flap would almost certainly have become necrotic as it was impossible to approximate edges without avulsed skin becoming white and avascular from tension.

and all of the other wounds appeared to have healed per primam externally." Of the gastric wounds, the ones sutured with silk regained their original strength and became stronger than the stomach wall in less time than did those sutured with catgut.

The premature absorption or digestion of catgut has been observed many times. This is manifested by disruption of the wound, a serious postoperative accident in which the entire wound completely comes apart. The prevalence of disruption in dehydrated patients has been known clinically for many years. It was particularly feared following operations for pyloric stenosis and recently Bird and MacKay have shown experimentally that dehydration greatly delays healing. H. S. Andrews of Louisville reported that he had seen disruption of wounds several times follow operation for pyloric stenosis when they were sutured with catgut but has never seen it following the use of silk. I have seen several cases of disruption

following the use of catgut but up to the present time have never seen it in a wound sutured with silk. My experience with silk has been fully as extensive as that with catgut. Cases of disruption following silk have been reported, however, in the literature. The disruption of an abdominal wound with the expulsion of abdominal contents is a terrifying accident. The proper way of treating this condition is to replace as gently as possible and without any attempt at cleansing, the abdominal contents and suture the abdominal wall loosely with interrupted through-and-through sutures of silver wire or silkworm gut.

That catgut excites greater reaction in a wound than does silk has been demonstrated many times. This was done by palpating wounds sutured with the two materials. Other factors being the same there was always more swelling, more induration, and more tenderness in the wounds made with catgut.

Silk when properly used in clean wounds gives a lower percentage of infections and a higher percentage of primary union than does catgut. Beginning in 1925 I made a study of wounds at the Pitt Community Hospital in Greenville, North Carolina. The results were published* and were briefly as follows: Using a non-absorbable suture (silk or linen) 95 per cent of wounds resulted in firm primary union. Using catgut only 90 per cent of wounds resulted in primary union. In this study any discharge of serum or pus regardless of how small in amount or any separation of wound edge, no matter how slight, was counted as sufficient to consider the case one of faulty union.

In 1924, Goff of the Woman's Hospital in New York gave the following figures in a study of 2755 clean abdominal incisions. Of these, 1645 incisions closed by absorbable sutures resulted in extensive infections in 4.7 per cent of cases and slight infections in 5.3 per cent; 1110 incisions closed by non-absorbable sutures resulted in extensive infections in only 2.1 per cent and slight infections in 1.9 per cent. There was a 6 per cent decrease in infected cases when non-absorbable sutures were used. It is interesting to note that their figures are almost identical with the ones at the Pitt Community Hospital. More recently Meleney of the Presbyterian Hospital in New York made this statement following an extensive study of wound infections:

FIG. 3. *X*-ray before operation of extensive injury of ankle extending into joint. Shadows near lower end of fibula are of gravel imbedded in tissues and illustrate importance of thorough debridement.

> Certain types of operation seemed to favor wound infection. Up to 1929, a particularly high incidence of infection occurred in radical mastectomies, thyroids, open reduction of fractures, recurrent and ventral hernias, double operations and excision of lipomas. There seemed to be a plausible explanation for all but the thyroids. In this group we were getting

* *Southern Med. & Surg.*, July, 1927.

not only a high incidence of infection but many hematomas. Most of the thyroids were being done by the two surgeons connected with the thyroid clinic. In the summer of 1929, in the absence of one of these surgeons, one of the staff, who had recently come from another clinic where silk was being used more generally, operated on five thyroids and used silk instead of catgut. The soft, clean healing of these wounds was seen by the second thyroid surgeon and he decided to try it. He operated on 10 cases with silk and then on 10 with catgut. The silk cases all healed cleanly and the catgut cases had four hematomas and two infections. Then he changed over entirely to the use of silk and a little later in May, 1930 the other thyroid surgeon followed his example. Since then practically all of the thyroids have been done with silk with marked reduction both of hematomas and infections.

This striking improvement in thyroid cases led to the greater use of silk in hernias and open reductions with equally gratifying results when the figures were completed for 1931.

The incidence of infection in open reduction fell from 26 per cent to 2 per cent and although there were some other changes in technic this seemed to be due almost entirely to the substitution of silk for catgut. We believe that this favorable response is probably due to the minimal tissue reaction which silk produces, to the greater security of hemostasis with silk and to the gentler handling of tissues which the use of silk requires.

Since coming to Louisville, the incidence of primary union of wound in my private practice has been studied. There is included in this study only wounds made under aseptic conditions, not previously infected and closed without drainage. Of wounds sutured with silk 96.3 per cent resulted in complete primary union and none of them suppurated.

As long as sutures are not too tight and the tissues are not approximated under tension it does not seem to make much difference whether interrupted or continuous sutures are used. In closing cavities (stomach, bladder, peritoneum, etc.) the continuous suture is often preferable as the suture-line becomes water-tight more quickly. In other places (fascia, muscle, skin) the interrupted sutures are probably better. With the interrupted suture one may use fine material which will break if tied too tightly, while with the continuous suture a stronger strand is necessary and there is danger of inadvertently having it too tight. Should one of several interrupted sutures give way little or no damage results while hernia or non-union is more likely to ensue if a continuous suture breaks. The interrupted also permits fluids to escape from a wound easily, thereby decreasing any tendency to tension within the wound.

Sutures are sometimes placed in the subcutaneous fat in an attempt to prevent stretching of the cutaneous scar. They seldom are of any usefulness, however. Fat heals poorly and its nutrition is so readily jeopardized that it should not be sutured unless there are clear indications. For the same reason though to a less degree muscles are but rarely sutured as proper approximation can usually be obtained by suturing their fascia.

Clean wounds are no longer drained. The drain prevents proper union at its point of insertion and it permits the entrance of bacteria into the wound. A sterile blood clot is less dangerous ordinarily than a drain. If within clean wounds there are fluids such as bile or urine which need to be withdrawn, then drainage is indicated. Hertzler has shown that rubber in wounds is irritating and should not be used unless it is desired for the wound to remain open sometime.

Most wounds should be dressed. A dressing serves several purposes. It protects the wound from clothing, bacteria, cold, heat; it absorbs discharges; it helps to immobilize. Tight dressings are injurious because they jeopardize the supply of blood. Extensive and snug abdominal dressings frequently embarrass respiration and promote the development of atelectasis. Many different materials have been used to dress wounds. Sterile cotton gauze is the most popular. The use of alcohol, iodine, bismuth powder, and other irritants

is contraindicated. Professor Mont Reid of Cincinnati dresses clean wounds with wet salt gauze which encourages the exit of serum and lessens the tension within the wound. I employ one strip of vaseline gauze next to the wound and apply over that a few layers of dry gauze. The vaseline is non-irritating and prevents the gauze from adhering to the wound. Rest of a healing wound is necessary but it should never be obtained at the expense of blood supply. During the World War a much larger percentage of primary union of sutured wounds resulted in the ones which were not transported immediately following operation than in those which were transported. Dr. H. Winnet Orr of Lincoln, Nebraska has emphasized the importance of adequate rest for all wounds. Dressings of clean wounds should not be disturbed until healing is well advanced. Any dressing of any wound entails the hazard of possible contamination with virulent bacteria.

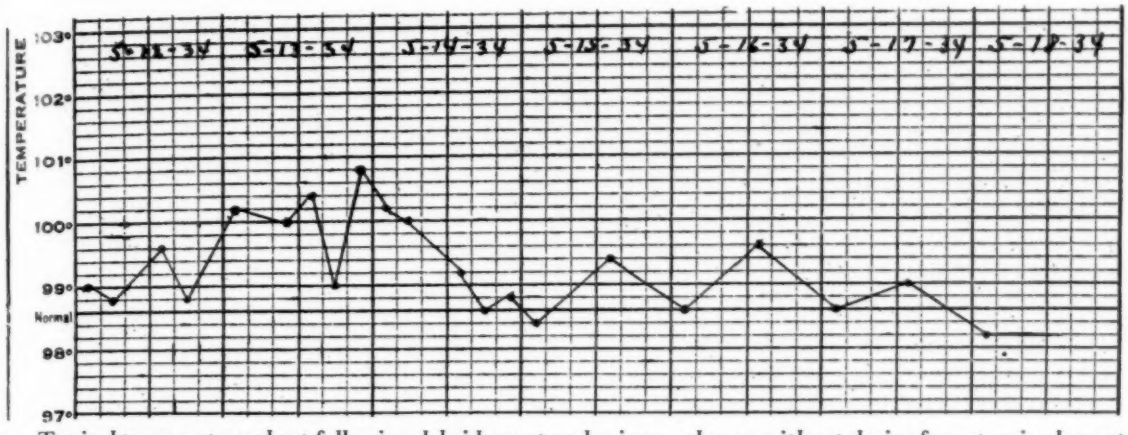

Fig. 4. Typical temperature chart following debridement and primary closure without drains for extensive lacerated and contaminated wound. Dressings not disturbed for nine days. Temperature remained normal after fifth day.

When the edges of a wound can not be approximated without tension leading to anemic necrosis it is preferable to forego completely closing the wound. If the defect is extensive a graft of some kind will be necessary. The principles of treating grafted wounds are exactly the same as those for sutured wounds. Approximation of the graft to the wound must be accurate and for this an elastic dressing such as a sea sponge is sometimes needed. Grafts should not be placed in saline solution as it delays coagulation between the graft and the wound. If a graft is unnecessary the same principles are to be observed as if a graft were used. This latter fact is frequently overlooked as one often sees a clean wound with a small defect which has been dressed daily with irritating applications. Each time a dressing is removed some of the delicate young cells which are attempting to close the wound are either killed or damaged and union delayed. Many cases can be cited to illustrate the injuriousness of frequent dressings. A recent one is that of a healthy child who had an ulcer of the leg of ten weeks' duration. Dressings had been applied once or twice each day and the ulcer was getting larger. Healing was obtained within a few days simply by permitting each dressing to remain at least five days. Zinc oxide adhesive plaster makes an excellent dressing for such wounds. It has satisfactorily and frequently been used for skin grafts. Tannic acid crusts make suitable dressings for clean wounds. They are non-irritant, protective and remove from one the temptation to change the dressing too frequently. For the dressing of beds from which grafts have been removed tannic acid is highly recommended by W. G. Maddock of Ann Arbor.

Before leaving the subject of clean wounds permit me to say to those of you

who are not accustomed to using it, a few more words concerning the use of silk. Should infection ensue or should there be a serous discharge from the wound, do not be alarmed concerning the fate of the silk. If fine strands have been used they may or may not be extruded from the wound. Most frequently they will not be extruded but will become encapsulated and will not delay union. Many times fine silk has been purposely used in infected wounds (appendicial abscesses, etc.) in which drainage tubes were used and the wounds have healed nicely around the tubes.

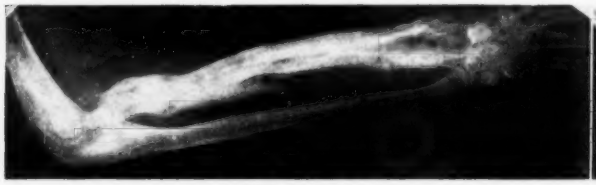

Fig. 5. Fig. 6.

Fig. 5. Chronic osteomyelitis of radius with multiple sinuses.

Fig. 6. Same as Figure 5 following Orr treatment. All sinuses healed. Good function. First dressing six weeks after operation. Subsequent dressings every two weeks.

Particularly in the treatment of hernias does the user of silk have an advantage over one who uses catgut. He not only has fewer infections but there is the added security of not having premature absorption of the suture leading to recurrence. Those who use silk in hernias never need sutures made of fascia a refinement of technique which to me has always been cumbersome and unnecessary. Amputation stumps are noted as frequent sites of infection and delayed healing. In them, whenever possible, one should use through-and-through non-absorbable sutures very loosely tied and make no attempt to get a linear approximation of the skin. Also, drainage of amputation stumps should not be practiced as drainage tracts are slow to heal. If infection is feared leave the stump open and practice secondary suture at a later date.

TREATMENT OF CONTAMINATED WOUNDS

Pathogenic bacteria are so prevalent that any wound not made under aseptic conditions should be considered contaminated. Through clinical experience surgeons have learned that after a contaminated wound is twelve to twenty-four hours old it is no longer safe to consider it as merely contaminated but should then consider it infected. We speak then of the first twenty-four hours as the period of contamination and any time subsequent to that as the period of infection. There is a difference in the treatment of the two periods. Under twelve hours unless grossly soiled with pus or fecal material it is safe to consider all as merely contaminated. Between twelve and twenty-four hours one must rely upon appearance of the wound. If there are no signs of reaction it is usually safe to consider it just contaminated.

In treating contaminated wounds the depths of the wound should be exposed, foreign bodies should be removed, necrotic tissue excised and hemorrhage stopped. The principles of gentleness as elucidated under the treatment of aseptic wounds should be observed carefully. If the wound can not be made grossly clean by these measures, irrigation with saline but not with antiseptics may be done. I personally rarely use any irrigation as there is danger of carrying bacteria into the recesses of the wound. Whenever possible hemorrhage should be stopped by pressure with dry gauze as ligatures increase the chances of infection. The measures just described were brought to a high degree of efficiency by the French surgeons during the World War. They employed the terms debridement, excision, and extraction as descriptive of this treatment. Debridement means literally an unbridling of the wound and the French meant by it a wide exposure of the wound. Our usage of the word in the

United States has come to mean all three procedures (debridement, excision, extraction). The mechanical cleansing of the wound must be thorough though structures such as vessels and nerves necessary for function or life must be preserved carefully and an effort made to protect them. Following this cleansing, the wound should be loosely sutured provided suture can be accomplished without putting any of the tissues upon tension. Immobilization of the part is then required until healing is complete. During the healing of multiple wounds and wounds other than very small ones the patient should have absolute rest in bed. Here again the experience of the war was valuable as the transported wounds did not heal as well as those which were kept quiet.

If it is necessary to transport the patient or if it is impossible to close the wound with sutures, the wound should be loosely packed with vaseline gauze, amply dressed with dry gauze, and properly immobilized, plaster casts being sometimes required. Provided the patient is free from pain and the temperature promptly reaches normal and remains there, wounds treated by this method of packing should not be disturbed until healing is complete or at least well-advanced. The time of healing depends on the depth and extent of the wound and the condition of the patient. If the wound is superficial the first dressing should be done at the end of seven to ten days. If larger or deeper, the dressing should not be disturbed for two to six weeks depending upon the size of the wound and the patient's condition. If the odor should become offensive or the dress unsightly the outer layers may be changed. Early changing of the inner dressing leads to infection. Orr has repeatedly emphasized this fact and I know from personal experience that he is correct.

Treatment of Infected Wounds

For purposes of treatment infected wounds may be divided into two classes: the acutely infected and the chronically infected.

The first essential in treating an acutely infected wound is rest. This can best be obtained by means of cases, splints, suspension, traction, bandages, adhesive strapping, braces, and rest in bed. Whatever method is used to be sufficient it must overcome muscle spasm. John B. Murphy constantly stressed the value of traction in treating infection of joints because it was the most adequate method of putting joints at rest. In the words of Hugh Owen Thomas rest must be "continuous, prolonged and uninterrupted." The next essential of treatment is to relieve tension within the wound. This is ordinarily spoken of as drainage but more than simple drainage by tubes or gauze is necessary as the entire length and breadth of the wound must be open. In obtaining this exposure care must be exercised not to carry infected material into normal tissues and if a spreading lymphangitis is present it is usually wise to wait until localization has taken place. If the wound is free from sloughs, packing loosely with vaseline gauze is nearly always sufficient. If sloughs are present Dakin's solution (surgical solution of chlorinated soda) or Wright's solution (hypertonic saline) are used to digest them, my preference being Wright's solution. Great credit is due Wright and Fleming of England for demonstrating the utter uselessness and even harmfulness of the ordinary antiseptics in treating infected wounds. They also showed that the virtue of Dakin's solution lay not in its antiseptic properties. They believed that the good results of Dakin's solution were due to its exerting an action similar to that of the hypertonic saline solution. The action of this saline solution in wounds was thoroughly studied and it was shown that the saline solution was superior to Dakin's solution and other antiseptics. Its beneficent action was shown to be due to its causing serum and leucocytes to enter the wound. The saline solution destroyed leucocytes which liberated tryspin. The trypsin digested the necrotic tissue. While this was in progress the serum diluted the saline sufficiently to stop its destructive action and permit more leucocytes to

enter the wound. With each application of saline this process was repeated.

I employ these solutions by a modified Carrell technique. One or more small rubber tubes are led to the depths of the wound. The tubes are secured with adhesive tape or cotton bandage and the wound loosely and abundantly dressed with gauze. A small quantity of warm but not hot solution is gently introduced into the tubes every two hours during the day and three hours at night. The dressings are changed every four to five days and the tubes are not removed until it is intended to leave them out entirely. When the wound appears to be free from sloughs, granulations grow in and the temperature remains normal for four days, the interval between irrigations is increased. Soon the irrigations are discontinued. The condition of the wound and the general condition of the patient rather than bacteriologic studies are relied upon to determine this time of stopping the irrigations. If stopping them does not result in an elevation of temperature the tubes are removed, the wound loosely packed with vaseline gauze, dressed and permitted to heal with as little interference as possible.

After the infection in these wounds has disappeared secondary suture of them has been practiced by some. Smears were made from the wound if there were no streptococci and fewer than six other bacteria per field upon three successive days secondary suture was considered safe. My own experience with secondary suture has not been happy so I no longer practice it.

In chronically infected wounds I follow the method of Orr. Necrotic tissue is gently removed, the wound packed with vaseline gauze and absolute rest obtained. No sutures, no tubes, and no foreign bodies other than the gauze are used. The first dressing is done two to six weeks later.

Such satisfactory results have been obtained with this method that I have not used maggots or bacteriophage.

In wounds which do not heal promptly, and this particularly applies to ulcers, bacteriologic studies should be made. Many unsuspected infections of blastomycosis, actinomycosis and other less frequent infections will be discovered. A most instructive case of this nature was shown to me last year by Dr. Clyde McNeill. A physician had an intractable wound of the hand the exact nature of which was not known until Dr. McNeill demonstrated Donovan bodies by anaerobic cultures under helium.

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CONGENITAL DEFECTS OF THE LUMBOSACRAL JOINTS

WITH ASSOCIATED NERVE SYMPTOMS*

A STUDY OF TWELVE DIFFERENT TYPES WITH OPERATIVE REPAIR

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INTRODUCTION

As medical knowledge has advanced beyond the state of description of symptoms, the mysteries of low back pain with sciatic involvement are gradually being cleared up. It is now definitely known that pain in the sciatic region can be due to one of many different causes. Among these may be diseases of the spinal cord, diseases of the bones and joints of the spine or pelvis, diseases of the neighboring muscles, diseases of the sciatic nerve itself or the roots entering into its formation, vascular or static diseases, herniae, metabolic disorders and pathological mental states.

In view of this fact, I will attempt to describe and classify twelve congenital anomalies of the sacrolumbar region which produce referred pains in the extremities. These symptoms are noted in patients who are remarkably healthy and have been steady workers throughout their lives, and the only disabilities of which they have complained were the recurrent pains in the back and limbs and of deformity.

CLASSIFICATION

The cases have been classified as to description of their *x*-ray findings and their neurological charts which show the root segments from which pain has been referred to the lower extremity or extremities. For a complete description, the appended case record can be referred to.

1. Elongated transverse process of left fifth lumbar vertebra which articulates with and is fused apparently to the ilium. Productive changes are seen between the fourth and fifth lumbar vertebra. Neurological chart shows referred pain L_3, L_4, L_3, S_1, S_2.

2. Unilateral sacralization of left lumbar transverse process which articulates with the upper part of the sacrum. A destructive and productive lesion is noted in the pseudo-arthrosis. There is failure of fusion of the upper segment of the sacrum. Neurological chart shows pain referred to opposite side of lesion S_1 and S_2.

3. Bilateral sacralization of the fifth lumbar transverse processes and these processes articulate with the upper part of the sacrum. A productive and destructive lesion is noted in the pseudo-arthrosis on the right. There is failure of fusion of the upper sacral segment. Neurological chart shows referred pain S_1 and S_2.

4. Extensive lateral lumbar curve with sacralized transverse lumbar process on the left. There is a destructive and productive lesion in the pseudo-arthrosis. There is narrowing of the joint space between the fourth and fifth lumbar vertebrae on the right. The neurological chart shows referred pain L_5, S_1, S_2.

5. Left sacralized transverse process of the fifth lumbar vertebra which articulates with the upper part of the sacrum. There is complete absence of the laminae and the spinous process of the fifth lumbar vertebra. Neurological chart shows referred pain S_1, S_2.

6. Bilateral sacralization of the fifth lumbar vertebra. The transverse process

* From The Hospital for the Ruptured and Crippled.

in the right articulates with the sacrum and the left is apparently free. There is absence of the spinous process of the fifth lumbar vertebra. The lateral view shows the fifth lumbar body to have slipped forward. Neurological chart shows referred pain L_3, L_4, L_5, S_1, S_2.

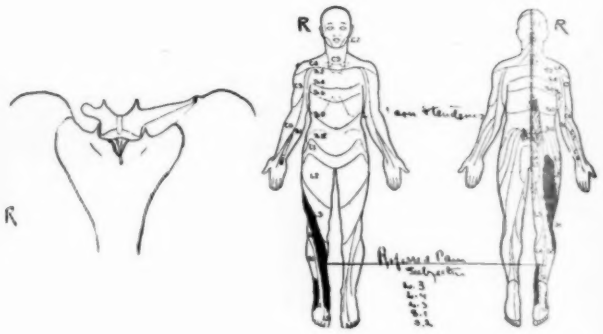
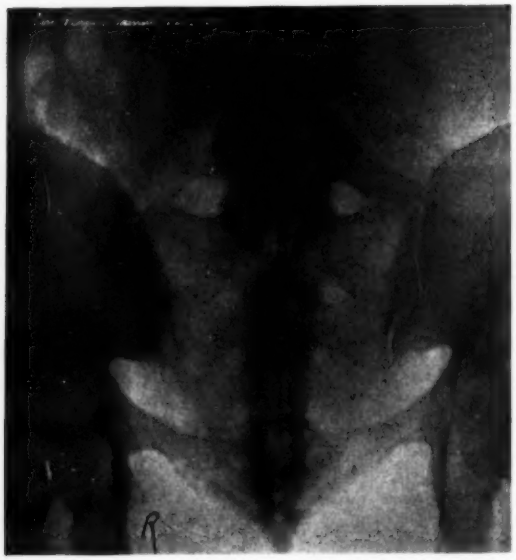


FIG. 1. *X*-ray reveals elongated transverse process of left fifth lumbar vertebra which articulates with and is fused apparently to ilium. Productive changes are seen between fourth and fifth lumbar vertebrae. Neurological chart shows referred pain L_3, L_4, L_5, S_1, S_2.

8. Failure of fusion of the first sacral segment. The sacrum is divided into two parts as the first sacral is of the lumbar type. The articular processes of the right lumbosacral joint are asymmetrical. Neurological chart shows referred pain L_5, S_1.



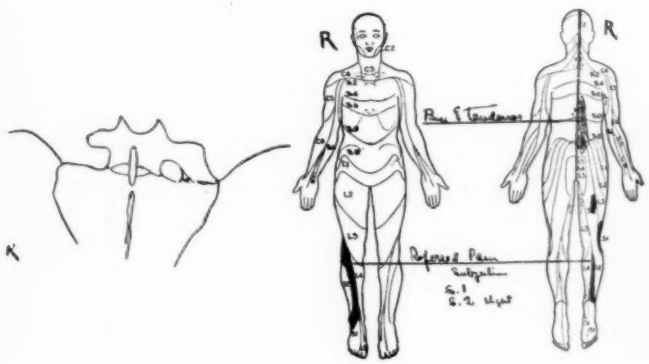


FIG. 2. *X*-ray reveals unilateral sacralization of left lumbar transverse process which articulates with upper part of sacrum. A destructive and productive lesion is noted in pseudo-arthrosis. There is failure of fusion of upper segment of sacrum. Neurological chart shows pain referred to opposite side of lesion S_1 and S_2.

7. Absence of the lamina (right) of the fifth lumbar vertebra and also loss of the articular facet of the right fifth lumbosacral joint. The lateral view shows marked increase of the lumbosacral angle. Neurological chart shows referred pain L_5, S_1.

9. Left lumbar curve with rotation of the fifth lumbar vertebra. There is spina bifida of the first sacral segment. The articular facets are irregular. The lumbosacral joint and joint space is narrower on the right than on the left.

Neurological charts show referred pain L_3, L_4, L_5, S_1, S_2.

10. Marked rotation of the last three lumbar vertebrae. There seems to be a collapse of the lumbo sacral joint and the facets are not superimposed. There is an attempt at sacralization of the fifth lumbar transverse process. The laminae and pedicles are poorly developed. Neurological chart shows referred pain L_1, L_2, S_1, S_2.

11. Rotary lumbar curve with loss of the articular facets on the right and diminution of articular space on the right lumbo sacral joint. There is a slipping forward of the fifth lumbar vertebra and lumbo sacral angle is 90′. The neurological chart shows the referred pain S_1, S_2.

12. Left lumbar curve with rotation of the fifth lumbar vertebra. The articular facets are absent and productive changes

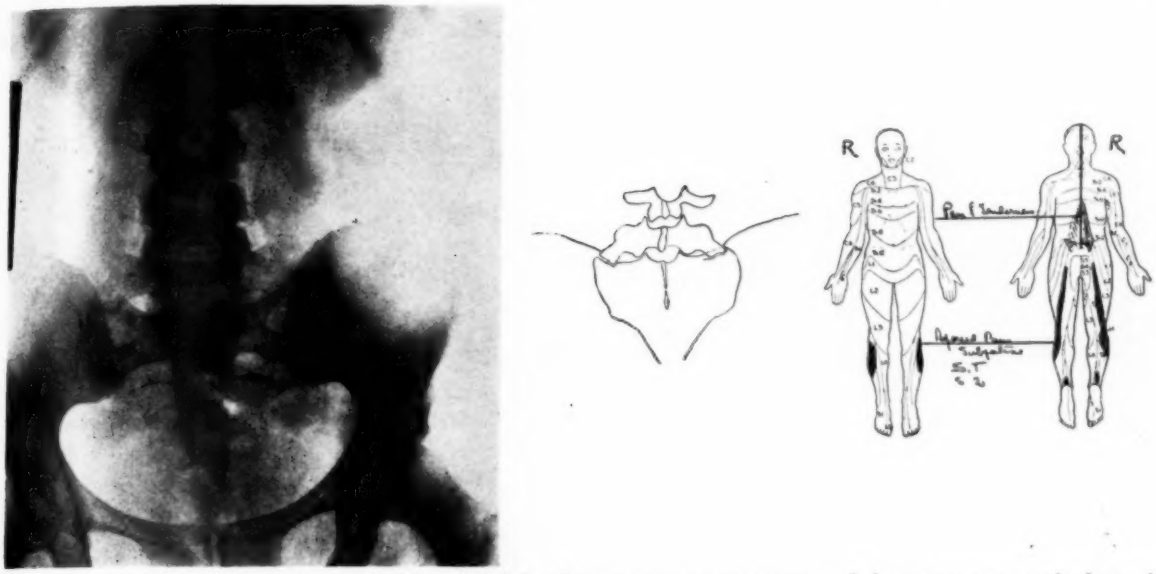


Fig. 3. *X*-ray reveals bilateral sacralization of fifth lumbar transverse processes and these processes articulate with upper part of sacrum. A productive and destructive lesion is noted in pseudo-arthrosis on right. There is failure of fusion of upper sacral segment. Neurological chart shows referred pain S_1 and S_2.

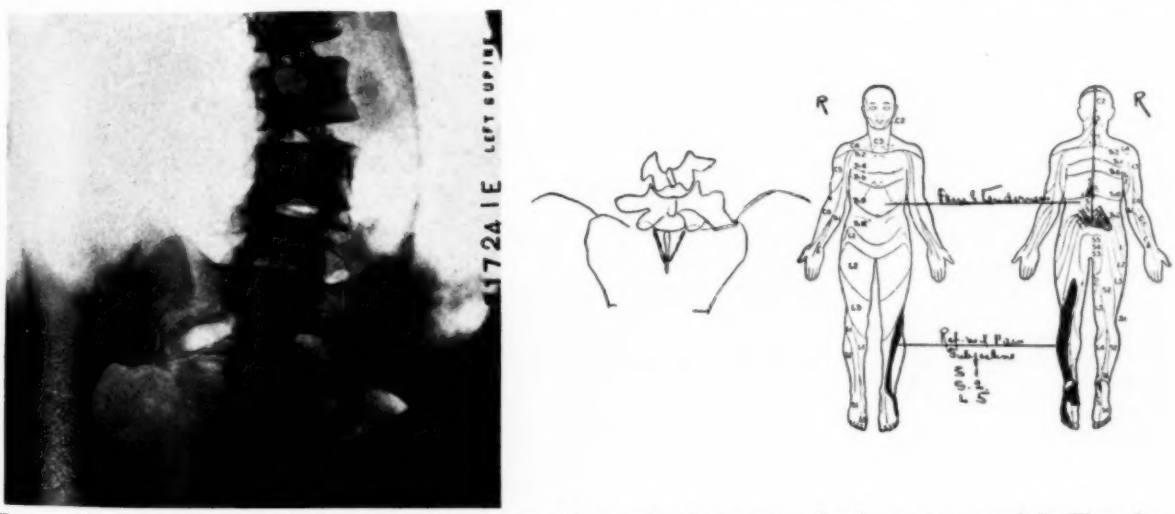


Fig. 4. *X*-ray reveals extensive lateral lumbar curve with sacralized transverse lumbar process on left. There is a destructive and productive lesion in pseudo-arthrosis. There is narrowing of joint space between fourth and fifth lumbar vertebrae on right. Neurological chart shows referred pain L_5, S_1, S_2.

have taken place. There is loss of articular space of the lumbosacral joint. Neurological chart shows referred pain L_5, S_1.

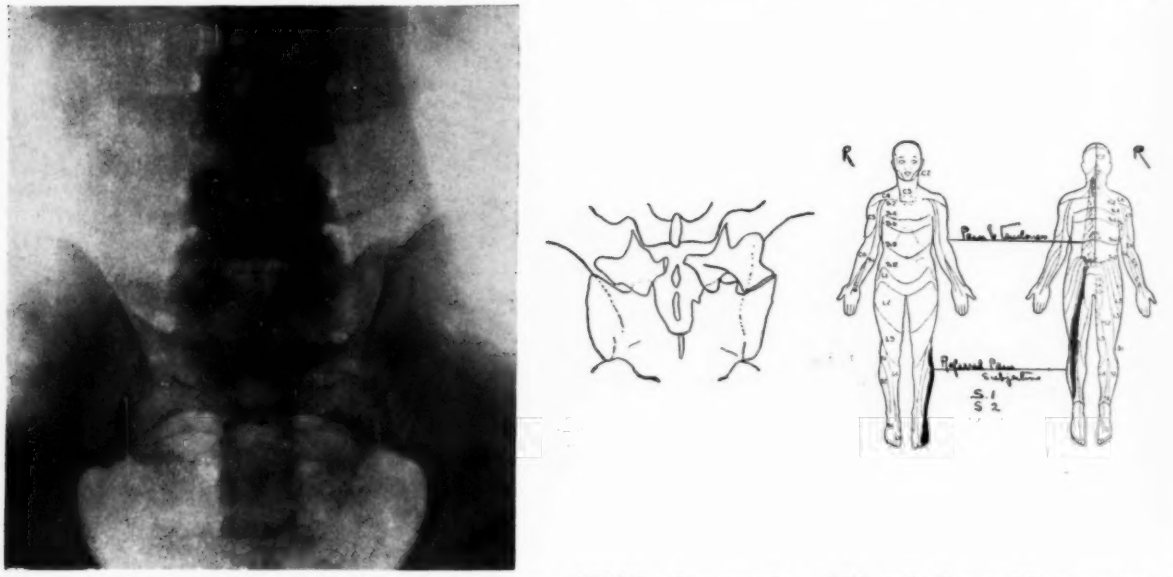


FIG. 5. *X*-ray reveals left sacralized transverse process of fifth lumbar vertebra which articulates with upper part of sacrum. There is complete absence of laminae and spinous process of fifth lumbar vertebra. Neurological chart shows referred pain S_1, S_2.

ETIOLOGY AND SYMPTOMATOLOGY

To Theodore Willis rightfully belongs the greatest credit for his complete anatomical works in reference to congenital lesions of the spine. In reviewing the classification in this series, one can find all types of defects, such as sacralized processes, bified sacrum, all types of spina bifida, loss of articular facets, and spondylolisthesis. Spondylolisthesis does not occur except with spina bifida which is associated with laminar and pedicle defects. Scoliosis seems secondary to the rotation and faulty weight-bearing surfaces of the lumbosacral joint. Arthritic changes of the infectious type have not been noted.

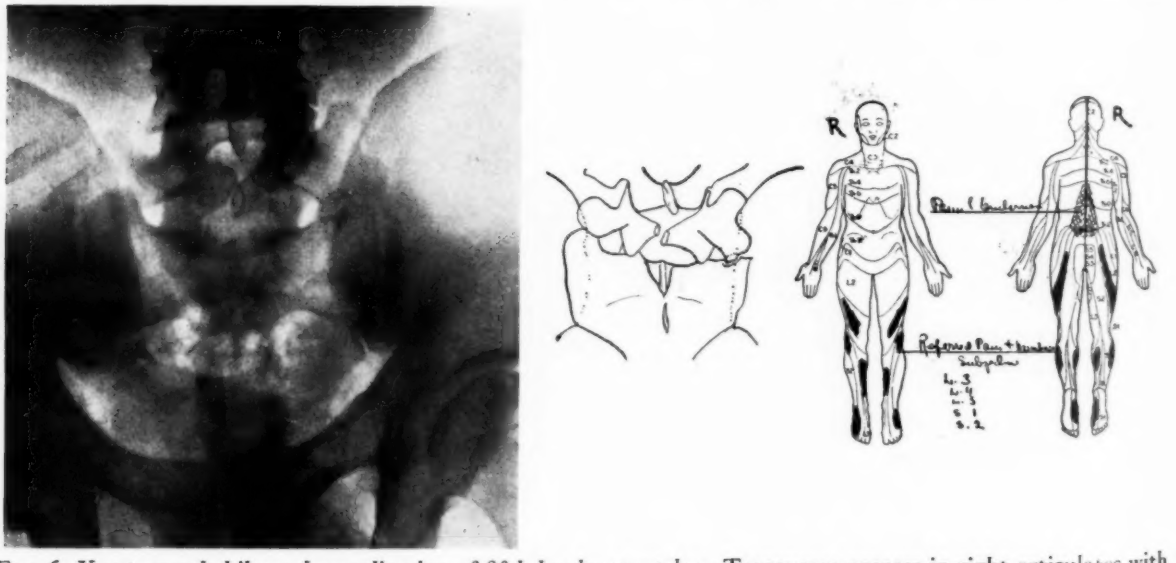


FIG. 6. *X*-ray reveals bilateral sacralization of fifth lumbar vertebra. Transverse process in right articulates with sacrum and left is apparently free. There is absence of spinous process of fifth lumbar vertebra. Lateral view shows fifth lumbar body to have slipped forward. Neurological chart shows referred pain L_3, L_4, L_5, S_1, S_2.

However, where there is a loss of articular facets, or where the sacralized process impinges upon the sacrum or the ilium, there are productive changes noted. Strange to say, sacroiliac lesions have not occurred in this study.

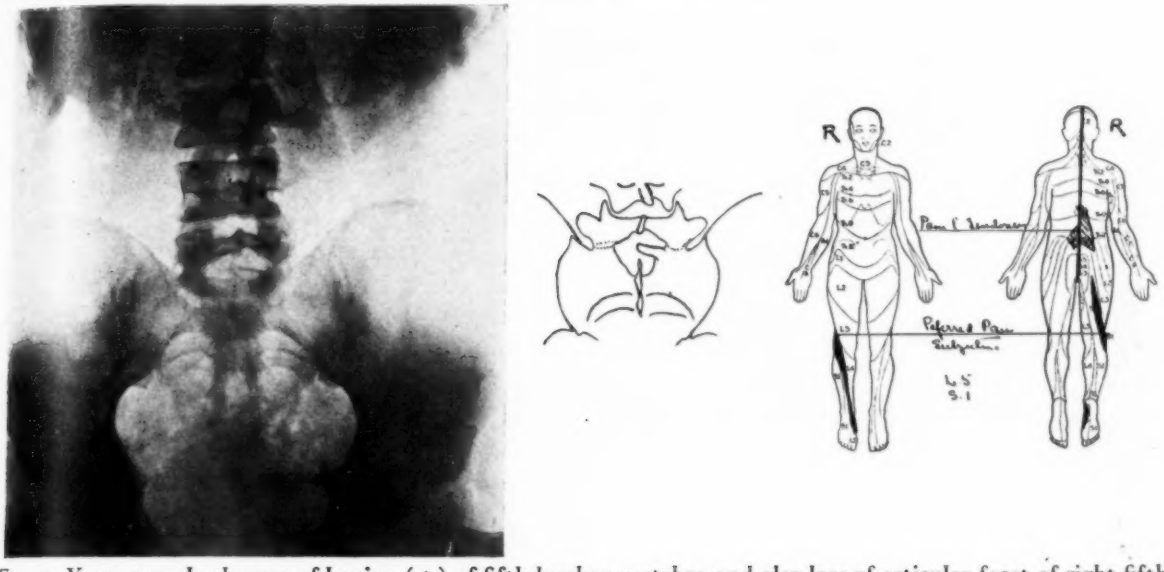


Fig. 7. *X*-ray reveals absence of lamina (rt.) of fifth lumbar vertebra and also loss of articular facet of right fifth lumbosacral joint. Lateral view shows marked increase of lumbosacral angle. Neurological chart shows referred pain L_5, S_1.

Table 1

DISTRIBUTION OF REFERRED PAIN

1. Pain in sacroiliac region	10
2. Pain at insertion of lumbar muscle (affected side)	12
3. Pain at insertion of lumbar muscle (bilateral)	1
4. Pain over sacrolumbar joint	10
5. Pain opposite side	1
6. Pain in gluteal muscles and hip	4
7. Pain to outer side of thigh and knee	5
8. Pain over sciatic notch	0
9. Pain along sciatic nerve	3
10. Pain about instep	5
11. Numbness about outer side of leg and calf	4
12. Could produce pain by certain movements	5
13. Lying down relieved pain	6
14. Trauma the cause of first symptoms (fall, lifting, etc.)	7
15. Duration of symptoms:	
1 case	18 years
2 cases	10 years
1 case	5 years
5 cases	4 years
1 case	3 years
2 cases	2 years
16. Age symptoms first appeared:	
1 at 18 years	
1 at 24 years	
1 at 25 years	
2 at 30 years	
1 at 32 years	
1 at 33 years	
1 at 34 years	
2 at 35 years	
1 at 36 years	
1 at 37 years	

The symptoms appear primarily because of the instability of the lumbosacral joint. Muscle spasm which is protective soon appears and finally the referred pain. The distribution of the referred pain can be noted in Table 1.

As can be seen from charts of these cases of lumbosacral anomalies giving pain in the lower extremities, the subjective pain is segmental in distribution being completely localized to the areas supplied by the third, fourth and fifth lumbar and first, second and third sacral segments. No real objective sensory findings have even been made out in these instances.

The distribution of the upper sacral nerves is one of the greatest found in any spinal nerves. The posterior divisions of the upper three of the sacral nerves divide into medial and lateral branches going to the multifidus muscle form loops on the posterior surface of the sacrum, send branches to the dorsal surface of the sacrotuberous ligament and form a series of loops under the gluteus maximus. *The lower two* sacral nerves are

small and lie below the multifidus and do not divide into medial and lateral branches but unite with each other and with the posterior division of the coccygeal nerve to form loops on the back of the lower part of the sacrum. Filaments from these loops supply the skin over the coccyx.

doubtless strain upon the joint capsule and ligaments is a big factor in the inflammatory process.

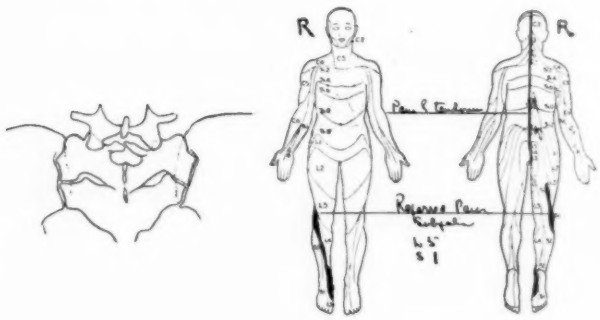


FIG. 8. *X*-ray reveals failure of fusion of first sacral segment. Sacrum is divided into two parts as first sacral is of lumbar type. Articular processes of right lumbosacral joint are assymetrical. Neurological chart shows referred pain L_5, S_1.

In the cases under consideration, it is believed that the inflammation about the spinal column and its articulations causes spasm of the lumbar muscles with a

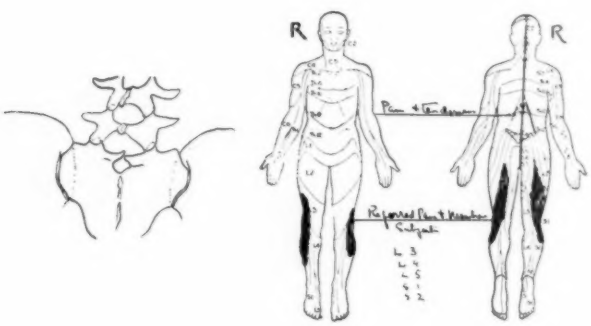


FIG. 9. *X*-ray reveals left lumbar curve with rotation of fifth lumbar vertebra. There is spina bifida of first sacral segment. Articular facets are irregular. Lumbosacral joint and joint space is narrower on right than left. Neurological charts show referred pain L_3, L_4, L_5, S_1, S_2.

All of us know that weight-bearing joint surfaces which are not properly opposed or in which the mechanical application of force is not correct will become inflamed and tender. Erosion may even take place. This might be called traumatic arthritis; physico-chemical irritation of them and a great deal of pull upon their periosteal attachments with a further demonstrable tenderness. Such irritability must be transmitted to the spinal cord over the nerves supplying the muscles, ligaments and

periosteum affected. There is no reason why reflex pain cannot be felt in other areas which are supplied by nerves from stretching of the brachial plexus over the scalenus anticus muscle, as noted in the presence of a cervical rib.

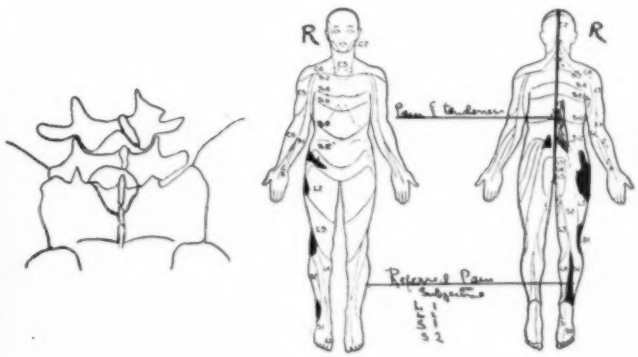


Fig. 10. *X*-ray reveals marked rotation of last three lumbar vertebrae. There seems to be collapse of lumbosacral joint and facets are not superimposed. There is attempt at sacralization of fifth lumbar transverse process. Laminae and pedicles are poorly developed. Neurological chart shows referred pain L_1, L_2, S_1, S_2.

the same dermatones (spinal cord segments). It is analogous to the abdominal pain which we have all seen in chest conditions.

In the extension of the referred pains, no doubt narrowing of the intravertebral foramina could produce pain in the lower extremities but not in any such bizarre shape as these charts show. It is definitely known that the dura is not adherent to the vertebral column except to the posterior longitudinal ligament. The dura is adherent to the spinal nerves as they make their exit from the spinal canal. However, with the change of the normal curves of the spine that appear in the third decade of life, at which time these symptoms are most often noted, the individual becomes less active. There are muscular ligamentous changes about the body especially the spine. With traction exerted upon the adherent dura to the posterior ligament, this force must be transmitted to the spinal cord, above the affected region. This in turn would no doubt give the referred pain in the extremities, similar to

TREATMENT

One should be on the lookout for these lumbosacral defects in childhood, because a certain amount of deformity can be prevented. Of course, this defect leads to some types of spinal curvature. Postural exercises in order to strengthen the muscles and the wearing of braces will often assist Nature in readjusting the articulations so that the individual can go through life without suffering. The greater number of these lesions of course are noted only in the third decade of life. Conservative treatment should always be tried which should consist of support, protecting the affected area and avoiding any undue strain. Massage and physiotherapy have not yielded good results in my series.

A large group which have continual pain with disabling attacks lasting from weeks to months should be treated surgically, and treatment should consist of repair of the lumbosacral joint by fusion of the last two lumbar vertebrae to the sacrum. When the sacralized transverse processes

of the lumbar vertebrae are present, the pseudo-arthroses between these articulations are destroyed. The Albee bone graft the affected side which resulted in an arthrodesis of the articulation relieved the pain.

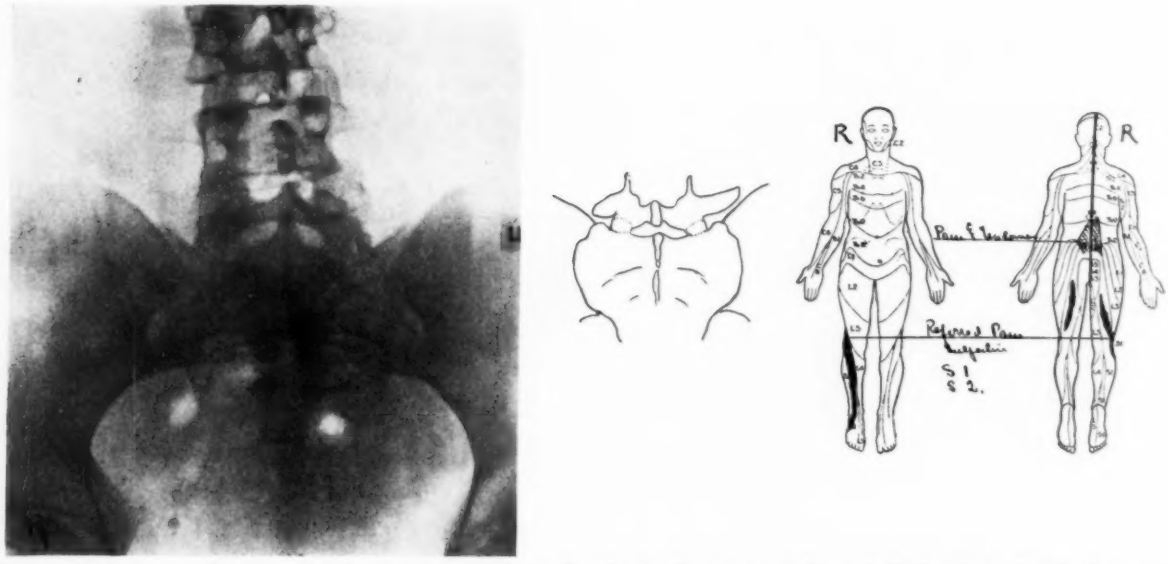


FIG. 11. *X*-ray reveals rotary lumbar curve with loss of articular facets on right and diminution of articular space on right lumbosacral joint. There is a slipping forward of fifth lumbar vertebra and lumbosacral angle is 90°. Neurological chart shows referred pain S_1, S_2.

is not sufficient in this type of case because the defect is so great. This was illustrated in one of Williams' cases which presented

The procedure that has been used in my series was of the Hibbs' type of spine fusion. The articulations were exposed and

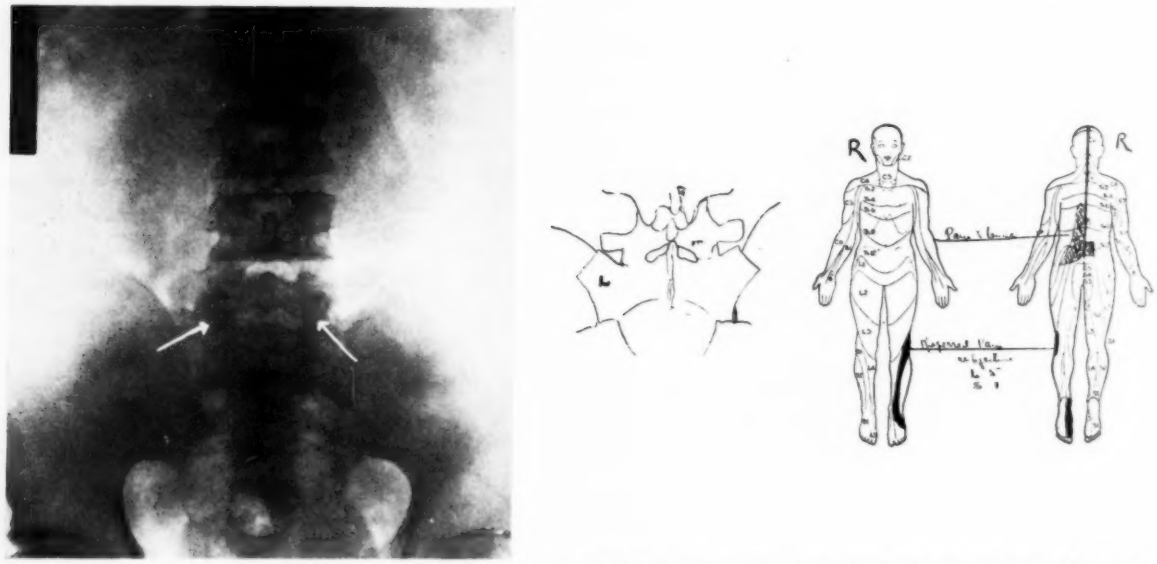
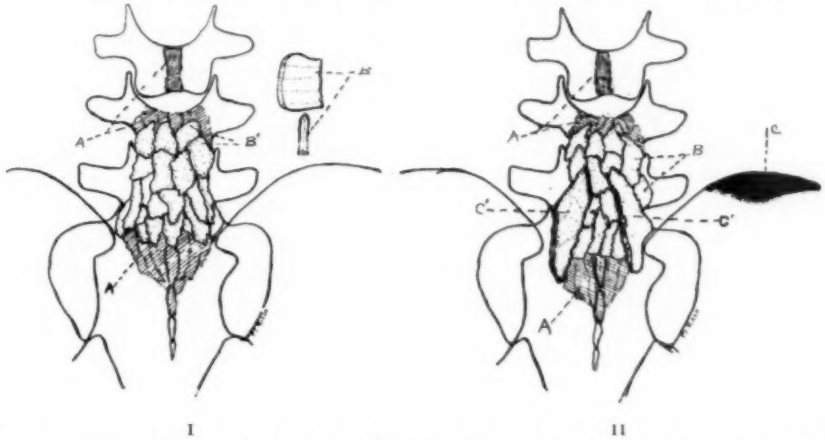


FIG. 12. *X*-ray reveals left lumbar curve with rotation of fifth lumbar vertebra. Articular facets are absent and productive changes have taken place. There is loss of articular space of lumbosacral joint. Neurological chart shows referred pain L_5, S_1.

a sciatic syndrome and the graft was implanted in the lumbosacral region, but the symptoms recurred. A facetectomy on

the spinous processes excised close to the lamina. The articular facets are removed thoroughly. The lamina are curetted and

with a small chisel chips of bone are placed across the articulations. The spinous processes are then cut up into small particles and replaced, thus reinforcing the affected area, giving a large amount of bone. This is illustrated in Figure 13, No. 1.



I II

Fig. 13. This shows two types of fusion used in repair of lumbosacral joint. Drawing 1 is ordinary Hibbs fusion. Drawing II illustrates how a graft has been removed from crest of ilium to reinforce weakened area.

Where there is an extreme defect due to the spina bifida, grafts of bone are removed from the iliac crest on either side and this is easily done through the original incision by retracting the erector spinae muscles inwardly. This bone is used first because of the ease in securing it and second it is analogous to the bones of the articulations in this area. The supplementary grafts are shown in Figure 13, No. II. The wounds are closed in the usual manner and the patient, after operation, lies upon his back in order to prevent any hemorrhage. He is kept on a convex frame for five weeks after which a plaster jacket is applied and walking is allowed. The patients wear support for at least a year until the *x*-ray shows extremely solid fusion and there is no recurrence of symptoms.

COMMENT

We must, as a rule, learn the exact anatomic structure and the lesion of the congenital variations of the lumbosacral joint if we are to make an accurate diagnosis and apply the proper treatment. Neurological study is always indicated.

Congenital lesions of the lumbosacral joint may be of a diversified nature but are more subject to strain than the normal vertebral articulations. The possessors of such variations are usually the individuals who go through life suffering from chronic undetermined backache, often with very little disability.

The defective articular facet is most of all to be associated with defects in the pedicle and laminae of the vertebrae. I see many cases of this sort at the Neurological Institute in New York and the Hospital for the Ruptured and Crippled. This type of case sooner or later presents neurological symptoms and signs. In an analysis of 12 cases of congenital defects of the lumbosacral joint, all of which have been studied and proved, the occurrence of pain was as follows: pain in the sacroiliac region, 10 cases; pain in the vicinity of the lumbar muscle of the affected side, 12 cases; bilateral, 1 case; pain over the sacrolumbar joint, 10 cases; pain on the opposite side, 1; pain in the gluteal muscle and hip, 4; pain over the sciatic notch, none; pain on the outer side of the thigh and knee, 5; pain along the sciatic nerve, 3; numbness about the outer side of the leg and calf, 4; pain about the instep, 5. This next is very important: could produce pain by certain movement, 5; lying down relieved pain, 6; trauma the cause because of sudden fall, 7 cases. As to the duration of symptoms: 1 case, eighteen years; 2 cases, ten years; 1 case, five years; 5 cases, four years; 1 case, three years;

2 cases, two years. Next is the age at which symptoms appeared: 1 case, eighteen years; 1 at twenty-four years; 1 at twenty-five years; 2 at thirty years; 1 at thirty-two years; 1 at thirty-three years; 1 at thirty-four years; 2 at thirty-five years; 1 at thirty-six, and 1 at thirty-seven years.

An illustrative case (No. 12) is as follows:

A man, aged thirty-six, of stocky build, came under my care in 1925 with the history of eighteen years of recurrent attacks of pain, deformity and disability in his spine and left leg. These attacks were brought on by the slightest unguarded muscular activity, such as leaning over to tie his shoe or to lift small objects. He had so much numbness, coldness and atrophy of the left leg that I felt sure he was suffering from a nervous condition. I did not appreciate the anomaly or absence of articular facets in this case until 1930, at which time a lumbosacral fusion was done with complete relief of pain. However, the numbness was the last symptom to disappear.

In lumbosacral anomalies the subjective pain is segmental in distribution, being completely localized to the areas supplied by the first, second and third segments. In the cases under consideration, the inflammation about the spinal column and its articulations causes spasm of the lumbar muscles with a physicochemical irritation of them and a great deal of the pull on their periosteal attachments with a further demonstrable tenderness. The rotation of the fifth lumbar vertebra associated with a too adherent dura to the spinal nerves as they make their exit from the vertebral foramina, or the narrowing of the intervertebral foramina, must transmit such irritability to the spinal cord over the nerves supplying the muscles, ligaments and periosteum affected.

CASE REPORTS

Case 1. Mary C., aged fifty-nine, October 3, 1931, Hospital for the Ruptured and Crippled.

Patient complains for many years of pain in her back and is known to assume an unusual posture when arising from a sitting position. In 1914, she had a so-called right "sciatic neuritis" and was in bed for several months. She complains mostly of pain in the lumbar region, the right hip and the right knee. At times it extends to the foot. The patient is never comfortable although after rest and wearing a brace she obtains relief.

Examination showed patient to be in fair condition. There was no evidence of polyarthritis about her terminal joints. As she stands there is a marked posterior curve in the dorsal region, the left shoulder higher than the right. There is a right lumbar left dorsal curve and loss of lumbar lordosis. Movements of the spine are lost because of extreme muscle spasm. Tests for sacroiliac disease are negative. There is no sign of abscess. There is tenderness about the lumbosacral joint. She keeps the right hip flexed in order to lessen the strain on the spine. There is some atrophy of the right leg. When she lies down the lordosis recurs and spasm in the muscle disappears.

X-ray examination shows a diminution and productive joint changes in the articular space of the lumbosacral joint. Anterior views of the *x*-ray show an elongated transverse process of the left fifth lumbar vertebra which articulates and appears to be fused to the wing of the ilium. The upper dorsal spine is tilted to the right. There are productive changes between the fourth and fifth lumbar articulations on the right. A thorough neurological examination and spinal puncture were negative.

Diagnosis: Right dorsal left lumbar curve. Congenital anomaly of the fifth lumbar vertebra. Elongated fifth lumbar processes on the left. Productive arthritis of the sacrolumbar articulations.

Operation: On October 10, the lumbosacral region was explored. The arthritic changes were noted between the fourth and fifth lumbar and lumbosacral joint. There was a spina bifida of the upper sacral segment which was not noted in the *x*-ray. The transverse process of the fifth lumbar was found to be fused to the ilium. A spine fusion was performed including the third, fourth, fifth and first sacral vertebrae, according to the Hibbs' technique. The patient had an uneventful recovery from operation. At the end of the fourth week the spasm disappeared. At the end of eight weeks a brace was applied and the patient was discharged from the hospital. One year later all support was discarded.

Re-examination on November 1, 1932, showed the patient to be free from pain. The spine was straight. There was loss of motion in the operative area, but the articulations above this region were freely movable. There was no evidence of pain in the leg or about the sacro-lumbar region. X-ray showed a bony fusion of the lumbosacral articulation.

Case II. Florence M., aged twenty-seven, December 6, 1929, Hospital for the Ruptured and Crippled.

For the past seven years, since the birth of her last baby, the patient has had attacks of disability in the lower spinal region. She continually complains of backache and has had several gynecological operations, without correcting the condition. Pain is most noticeable in the lower lumbar spine. It radiates to the right thigh down the posterior surface of the right leg and about the right ankle.

Examination: She is in splendid physical condition and as she stands there is a marked prominence of the right hip. Motions of the arms and upper extremities are normal. Flexion and extension of the spine are limited, hyperextension is accompanied by marked pain and lateral motions are restricted. The lumbar region appears longer than normal. There is prominence of the right hip and the right lumbar region is fuller than the left. There is spasm in both sets of the lumbar muscles. There is tenderness about the left lumbosacral joint. Motions of the hips are normal. Tests for sacroiliac joints are negative. Measurements of both legs are the same. Thorough neurological examination is negative.

X-rays show a congenital anomaly which consists of a sacralization of the fifth left lumbar transverse process. This process articulates with the upper portion of the sacrum and there is a destructive and productive lesion in the pseudo-arthrosis. There is a failure of fusion of the upper segment of the sacrum. There is no narrowing of the lumbosacral joint. The lumbar lordosis is lost.

Diagnosis: Sacralization of the fifth lumbar transverse process. Destructive and productive arthritis of pseudo-arthroses. Spina bifida occulta of the sacrum.

Operation: On December 7, 1929, the lumbosacral region was explored and the *x*-ray findings were verified. A spine fusion according to Hibbs' technique was performed including the third, fourth, fifth and first sacral articulations. The pseudo-arthrosis on the left was destroyed between the elongated transverse process and the sacrum. The patient made an uneventful recovery from operation. She remained in the hospital for six weeks, after which time a plaster jacket was worn for six months. A brace was then substituted and all support was discontinued at the end of the year.

Re-examination: On November 10, 1932, the patient was re-examined. The deformity was completely gone and the patient complained of no pain. The patient is very active and neurological examination was negative. She was discharged cured at that time.

Case III. Mary M., aged forty-one, April 15, 1928, Neurological Institute.

Patient stated that she had had periodical attacks of lumbago for the past six or seven years. Each time the attack was more severe. Six weeks ago she was admitted to the Neurological Institute complaining at that time of pain radiating down to the posterior surface of both buttocks and down the leg. There was considerable pain in the region of the lumbar muscles.

Neurological examination including spinal puncture was negative.

Examination at that time showed the patient to be in splendid physical condition and examination was negative except for the spine. Movement of the upper extremities and cervical spine was normal. There was a loss of lumbar lordosis but no lateral deviation of the spine. There was marked spasm in the lumbar muscles and motions completely lost in all directions. Movements of the hip were normal, but extension of the leg on the flexed thigh was impossible

X-ray examination showed a bilateral sacralization of the fifth lumbar transverse processes. These processes articulated with the upper portion of the sacrum. There was a marked destructive and productive lesion of the pseudo-arthrosis on the right. It was not so marked on the left. The articular facets of the lumbosacral joint were not evident. There was a spina bifida of the upper sacral segment.

Diagnosis: Sacralization, bilateral, lumbar transverse processes. Pseudo-arthrosis between these processes and the upper sacral segment. Destructive lesion of the right pseudo-arthrosis.

Re-admission: On April 28, 1929, the patient reappeared and had been wearing a Knight

spinal brace throughout the year with no improvement. The pain had increased considerably and now radiated down the left leg into the ankle. Examination at that time showed the stiffness to be the same.

She was admitted to the hospital and the sacrolumbar region was explored. The findings in the *x*-ray as described were verified.

Operation: A spinal fusion according to the technique of Hibbs was done which included the third, fourth, fifth and first sacral articulations. The pseudo-arthroses between the first sacrum and the transverse processes were destroyed.

The patient made an uneventful recovery from operation, remained in the hospital eight weeks, after which she wore a plaster jacket for one year.

Re-examination in October, 1931, showed the patient to be without symptoms. The spine was straight. Motions in the spine had returned except for the operative area. She complained of no symptoms about the legs except numbness when she was tired. X-ray showed a complete bony fusion extending from the third lumbar vertebra including the first sacral articulation.

Case iv. Helen K., aged thirty-five, May 5, 1925, St. Luke's Hospital.

The patient complained of pain in the back and down the left leg. In August, 1923, after getting wet, she noticed extreme pain in the left lower back and down the leg. This continued for about six weeks. She was treated with plaster and felt somewhat improved. She has had many recurrences of the attacks of pain, each time more severe.

Examination showed patient to be in splendid physical condition and was negative except for the spine. As she stands there is a right dorsal left lumbar curve. There is a marked prominence of the left hip and extreme spasm of the lumbar muscles. There is no tenderness about the spine articulations. There was no sign of abscess. Movements of the right leg were normal. Extension of the leg on the flexed thigh caused considerable pain and shows marked restriction of motion.

X-rays showed no evidence of arthritis. There was a marked left lumbar curve with rotation of the lumbar vertebra. There was a sacralization of the transverse process on the left. It articulated with the upper portion of the sacrum and there was evidence of bone destruction and production in the false articulation. The transverse process on the right was normal. Sacroiliac joints were normal.

This patient was admitted to the hospital because of extreme pain and a thorough neurological examination was performed and found to be negative.

Diagnosis: Right dorsal left lumbar curve. Sacralization of the fifth lumbar process, left.

Operation: On August 25, 1925, the lumbosacral region was explored and no other congenital defects were noted, except that described in the *x*-ray. A spine fusion was performed, according to the technique of Hibbs, including the third, fourth, fifth and lumbosacral articulations. The false process on the left was accordingly fused to the sacrum by destruction of the pseudo-articulation. She remained in the hospital six weeks. A jacket was applied which she wore for one year. Afterwards all support was discarded.

Re-examination on March 5, 1931, showed the patient to be completely free from pain. The spine was straight. There was loss of motion in the operated area. Neurological examination was negative and there was no residue of the referred pain in the leg. X-ray examination at that time showed a complete bony fusion of the lumbosacral joint.

Case v. William C., aged forty-five, June 30, 1931, Neurological Institute.

The patient complained of pain in the back and down the left leg, duration ten years. He was seen at the Neurological Institute and was bed-ridden at that time. He gave a history that for the past ten years he had been suffering extreme pain in the back and down the right leg. He was treated by numerous physicians and had removal of tonsils and teeth as his condition was considered a rheumatic affair and alcoholic neuritis. He had many *x*-rays and nothing unusual appeared to be noted in the *x*-rays by the examination physicians.

Examination: He was in splendid physical condition, but was in severe pain which made movements very difficult. The pain radiated down the posterior surface of the left leg about the external malleolus and the sole of the foot. He could reproduce pain by change of position. There was no evidence of arthritis about the terminal joints. As he stood there was a left dorsal right lumbar curve. There was marked spasm in the left lumbar muscles. There was a marked prominence of the left hip. All

motions were practically lost. Motions of the lower extremities were normal. However, there was some restriction of extension of the leg on the left thigh. A thorough neurological study showed no evidence of cord tumor or inflammatory involvement of the lumbosacral plexus.

X-ray showed the patient to have a congenital deformity in the lumbosacral region. There was a sacralization of the last lumbar vertebra on the left. The sacralized transverse process articulated with the upper portion of the sacrum. There was complete failure of fusion and absence of the laminae of the last lumbar vertebra and the first sacral vertebra. The lateral views showed loss of lumbar lordosis but no slipping of the fifth lumbar vertebra.

Diagnosis: Left dorsal right lumbar curve. Congenital defect of the sacrolumbar joint. Sacralization of the left transverse process of the fifth lumbar vertebra. Spina bifida with congenital absence of the laminae of the fifth lumbar and first sacral vertebrae.

Operation: On August 22, 1931, the lumbosacral region was explored. The findings were verified as described in the *x*-ray. A spine fusion was done according to the Hibbs technique, but because of the extensive defect, the ninth rib on the right was resected and divided lengthwise and used as a graft to bridge the defect from the third lumbar to the third sacral vertebra. The patient made an uneventful recovery from operation and at the end of six weeks was discharged wearing a plaster jacket.

Re-examination on November 20, 1932, showed that the patient had no complaint, no pain in the legs and the spine was straight. There was no prominence of either hip. Motions were lost in the operated area. Patient was discharged cured.

Case VI. George C., aged thirty-six, March 13, 1930, Hospital for the Ruptured and Crippled.

Patient states that two years ago, after lifting a heavy weight, he felt extreme pain in his back and has never felt right since. He has intermittent attacks of pain accompanied by deformity. He has had conservative treatment which consisted of jackets and belts but there has been no cure. He feels better when he rests. Pain is localized in the sacrolumbar region and he has a feeling of numbness and slight pain about the thighs and down both legs.

Examination shows him to be in splendid physical condition. There is no evidence of arthritis about the terminal joints. As he stands there is a left dorsal right lumbar curve. There is marked spasm in the lumbar muscles. There is an increased lordosis and the trunk seems to be shortened. The abdomen is more prominent than normal. All motions of the spine are restricted. Tests for sacroiliac disease are negative. When he lies down the curvature and the muscle spasm disappear. There are no particular points of tenderness except some sensitiveness about the lumbosacral joint.

X-ray examination shows no evidence of disease about the vertebral articulations. There is a sacralization, bilateral, of the fifth lumbar vertebra. There are pseudo-arthroses between the two articulations. There is a failure of fusion of the lamina of the fifth lumbar vertebra vertebra in the midline. There is a spina bifida occulta of the upper segment of the sacrum. Lateral views show a displacement forward of the fourth and fifth lumbar vertebrae. A thorough neurological study was negative.

Diagnosis: Left dorsal right lumbar curve. Spina bifida occulta. Sacralization of the fifth lumbar vertebral processes, bilateral. Failure of fusion of the lamina of the fifth dorsal. Spondylolisthesis.

Operation: On April 28, 1930, the lumbosacral region was explored and the findings noted as described in the *x*-ray. Spine fusion according to the technique of Hibbs was done including the third, fourth, fifth and first sacral articulations. The fusion was made more complete by the addition of a long graft removed from the tibia and placed from the third lumbar to the first sacral vertebra. This was thought wise because of the marked tendency to spondylolisthesis. He remained in the hospital six weeks and wore the plaster jacket for one year.

Re-examination December 10, 1932, showed patient to be back at work as an electrician. He complained of no pain and no sensory disturbance in the extremities. There was no deformity except a slight pendulous abdomen. Motion was restricted in the operated area. X-ray at that time showed a complete bony fusion without absorption of the bone graft.

Case VII. Henry F., aged thirty-two, March 14, 1930, Hospital for the Ruptured and Crippled.

Patient stated that he was perfectly well until two years previous when, after lifting a heavy weight he felt extreme pain in his back and had never felt well since. He felt relieved when he rested but any type of work or lifting produced pain which was localized in the sacro-lumbar region. The pain at times traveled down the posterior surface of the thigh into the ankle and about the instep. It was most noticeable on the right side.

Examination showed the patient to be in good condition. As he stood there was a left dorsal right lumbar curve. There was marked spasm in the lumbar muscles, most severe on the right. All motions were limited. Tests for sacroiliac disease were negative and when he lay down the curvature and muscle spasm disappeared.

X-rays showed a spina bifida of the last lumbar with a complete absence of the lamina of the right fifth vertebra. There was a loss of articular facets. There was a slight increase in the lumbosacral angle. There was a spina bifida of the upper segment of the sacrum. A thorough neurological examination was negative.

Diagnosis: Spina bifida. Absence of the lamina of the right fifth lumbar vertebra. Spina bifida upper segment of the sacrum. Unstable fifth lumbar vertebra.

Operation: April 28, 1930, the lumbosacral region was explored and the findings in the *x*-ray were verified. A spine fusion according to the technique of Hibbs was performed which included the third, fourth and fifth lumbar and the first and second sacral vertebrae. This amount of bone did not fill the defect due to the spina bifida and a segment of the iliac crest was removed, divided and transplanted across the defects of the lumbosacral joint. He made an uneventful recovery from operation and was discharged from the hospital at the end of seven weeks wearing a plaster jacket. Support was discarded at the end of a year and a half.

Re-examination in November, 1932, showed the patient to be back at work as an electrician. He complained of no pain. There was no limitation of motion or deformity except in the operative area. X-ray showed a complete bony fusion. The patient was discharged cured.

Case viii. Sister A., aged twenty-eight, January 27, 1931, Neurological Institute.

The patient gave a history that four years ago at the age of twenty-four, she fell from a chair and injured her back. Since then she had had more or less pain referred to the lumbosacral region. Pain continued down the outer border of the leg to the knee and right instep. She had considerable pain in the back of the neck.

Examination showed the patient to be in good condition and as she stood there was a right dorsal left lumbar curve with a prominence of the left hip. There was marked spasm in the right lumbar muscles. There was an increase in the lumbar lordosis. Extension and flexion were practically normal. Lateral motions gave pains in the lumbosacral region and down the right leg. She could produce or relieve this pain at will. There was some tenderness about the lumbar muscles. Extension of the leg on the thigh did not give pain and tests for sacroiliac disease were normal.

X-ray examination showed the curve as described. No evidence of organic disease was seen. There was a marked spina bifida, of the first sacral segment. There was absence of the spinous process of the first sacral vertebra and probably of the fifth lumbar. The sacrum was divided into two parts as the first sacral vertebra was lumbar in type. The articular facets of the right lumbosacral joint were asymmetrical. A thorough neurological examination including the spinal puncture was negative for disease.

Diagnosis: Congenital anomaly of the first sacral vertebra with absence of the spinous process.

Operation: March 21, 1931, patient was admitted to the hospital and the lumbosacral region was explored. The *x*-ray findings were verified and a spine fusion was performed according to the technique of Hibbs including the third, fourth, fifth and lumbosacral articulations. The patient made an uneventful recovery from operation and at the end of eight weeks was discharged from the hospital wearing a plaster jacket. Support was completely given up at the end of a year.

Re-examination: May 7, 1932, the patient was re-examined, complaining of no pain or numbness about the legs. She could not produce any pain by change of position. There was loss of motion in the operative area and *x*-ray examination showed the bony fusion to be complete at that time.

Case ix. Helen H., aged thirty-three, March 18, 1929, Hospital for the Ruptured and Crippled.

For many years she had noticed pain and weakness in the spine. She complained of a chronic backache with a feeling of numbness about both buttocks and around the thighs. Bending aggravated the pain and by change of position she could either reduce the numbness or relieve it.

Examination showed the patient in good condition. There was no evidence of arthritis about the terminal joints. Otherwise, examination was negative except for the spine. The spine was very long except in the lumbar region and the patient had a very poor posture. As she stood there was a marked degree of round shoulders and a posterior curve in the dorsal region. There was a prominence of the right hip. The right lumbar space seemed to be fuller than the left. All the spinous processes from the eighth dorsal to the fifth lumbar were very prominent. The lordosis was lost. Motions were not particularly restricted. There was no evidence of sacroiliac disease. As she lay down the curve disappeared and the lumbar spaces were normal. Thorough neurological examination was negative.

X-ray examination showed no evidence of a productive arthritis. There was a right dorsal left lumbar curve with rotation of the third, fourth, and fifth lumbar vertebrae. There was a spina bifida which involved the first sacral segment. The articular facets were asymmetrical on the right and very irregular. The lumbosacral joint space on the right seemed to be narrower than the left. The lamina of the first sacral vertebra were present but the spinous process was absent. There was marked rotation of the fifth lumbar vertebra.

Diagnosis: Spina bifida of the sacrum. Rotation of the fifth lumbar vertebra. Asymmetrical lumbosacral facets. Increased lumbosacral angle.

Operation: On April 27, 1929, the lumbosacral angle was explored. The *x*-ray findings as described were verified and the spine fusion according to the Hibbs technique was done, extending from the third lumbar through the first sacral vertebra. A large piece of bone was removed from the iliac crest and divided. The segments of bone were then placed over the operative area in order to reinforce the fusion. The patient made an uneventful recovery from operation and was discharged from the hospital wearing a plaster jacket at the end of six weeks, which was worn continuously for eight months, after which a corset was substituted.

Re-examination: July 13, 1931, patient was examined again. She had gained considerable weight. He had no pain except a dull ache at times in the lumbar muscles. She held herself very erect and there was loss of motion in the operative area. *X*-ray showed a complete bony fusion.

Case x. Gertrude O., aged thirty-six, January 26, 1927, Hospital for the Ruptured and Crippled.

The patient gave a history of having a deformity of the spine since childhoood. Since the birth of her children she had had a progressive increase of pain in the right lumbar region. After delivery of the last child, the pain became very extreme after sudden movements such as bending forward or stooping. The pain radiated about the right hip, the crest of the ilium and down the right leg posteriorly, and ended about the ankle. It was always present on the right side. The curvature of the spine had become more severe.

Examination showed the patient to be in fair physical condition. She walked protecting the spine and with a slight limp on the right side. There is no evidence of polyarthritis about the terminal joints or any deformity except the spine. As she stands she holds herself fairly erect. There was a right dorsal left lumbar curve. Motions are restricted in all directions. There was a marked concavity in the left lumbar region. There appeared to be rotation of the lumbar vertebra.

X-ray examination showed no evidence of destructive arthritis about the spine, but there was a marked rotation of the lumbar vertebra. There seemed to be a collapse about the right lumbosacral joint. The fifth lumbar vertebra appeared to project laterally. The articulation of the fifth lumbar with the sacrum was very unstable. The articular facets on the left were not superimposed. There was an attempt at sacralization of the fifth transverse process, lumbar, on the right. In the lateral view, the lumbar lordosis was lost. Thorough neurological examination was made, including spinal puncture and no evidence of neurological disease was elicited.

Diagnosis: Right dorsal left lumbar curve. Rotation of the lumbar vertebra. Spina bifida. Sacralization of the transverse lumbar process right. Asymmetrical articular facets. Unstable fifth lumbar vertebra.

Operation: On February 16, 1929, the patient was admitted to the hospital and the lumbosacral region was explored. The findings as shown in the *x*-ray were noted. A spine fusion according to the Hibbs technique was performed, including the third, fourth, fifth lumbar and the first sacral vertebrae. A large graft was removed from the tibia and placed from the third lumbar vertebra to the sacrum in order to make a massive bony fusion because of the marked instability of the spine. She made an uneventful recovery and was discharged wearing a plaster jacket at the end of six weeks. Support was worn for an entire year and after that time she was discharged.

Re-examination on December 13, 1930, showed the patient to be in splendid physical condition. The spine was fairly straight. There was no lumbar spasm. There was loss of motion in the operative area. There were no pains referred to the legs and she was very active. *X*-ray at that time showed a complete bony fusion with partial absorption of the bone graft.

Case xi. Julie S., aged thirty-nine, March 30, 1929, Hospital for the Ruptured and Crippled.

For twelve years the patient had complained of pain in the lower lumbar region and about the right thigh and down the right leg. There had been a sensation of numbness about the left hip region. When she was tired the pain was aggravated and at times quite disabling. After lifting heavy bodies she was forced to take to her bed for a few days. After rest she felt relieved, and the wearing of belts and corsets had not improved the condition. It seemed to become progressively worse.

Examination showed the patient to be in splendid physical condition. There was no deformity about the body except the spine. As she stood there was a right dorsal left lumbar curve. There was spasm in the right lumbar muscles. There was tenderness about the right lumbosacral joint and at the insertion of the left lumbar muscles. Movements of the hips and legs were normal. There was no atrophy. However, the right leg did not appear as well developed as the left. There was no evidence of disease of the sacroiliac joints.

X-rays of the entire spine showed no gross abnormalities in the cervical region. There was some calcification in the anterior ligaments of the lower dorsal vertebral region. In the lumbar region there was a moderate right rotary lateral curvature with a marked increased lumbar lordosis with a slipping forward of the fourth and fifth lumbar vertebrae. The lumbosacral angle was almost 90°. There was a diminution of the articular space on the right of the lumbosacral joint. The facets were asymmetrical. A thorough examination showed no disease of the nervous system.

Diagnosis: Right dorsal left lumbar curve. Spondylolisthesis. Congenital absence of the articular facets of the right lumbosacral joint. Unstable fifth lumbar vertebra. Increased lumbosacral angle.

Operation: On May 14, 1929, the lumbosacral region was explored. No other defects were noted except those described in the *x*-ray. A spine fusion according to the Hibbs technique was performed including the third, fourth, fifth and lumbosacral articulations. At the end of six weeks the plaster jacket was applied which she wore on her discharge from the hospital. She wore this support for about nine months.

Re-examination on July 19, 1931, showed the patient to be in splendid physical condition and support was not necessary. She complained of no pain. There was no feeling of numbness about the extremities. *X*-ray showed the spine fusion to be complete and no motion in the operative area. She was discharged cured.

Case xii. Morris K., aged thirty-eight, July 14, 1925, Hospital for the Ruptured and Crippled.

For eighteen years the patient had complained of trouble with his back. There had been a recurrence of pain and deformity, especially after exercise. The last attack was treated by Dr. Frauenthal with injections. Three weeks ago, while throwing some coal into a furnace he developed severe pain in the left lumbar region with radiation down the leg.

Examination at that time showed patient to be in good condition. Motions of the spine were limited in all directions. There was a right dorsal left lumbar curve with marked spasm in the lumbar muscles. He was subjected to a thorough general examination including neurological tests. Neurological examination was negative. No evidence of cord tumor.

The *x-ray* showed asymmetry of the articulations of the lumbosacral joint with rotation of the fifth lumbar vertebra. There was marked bone production about the left lumbosacral joint.

Diagnosis: Right dorsal left lumbar curve. Atypical lumbar articular facets. Congenital absence of facets on the left.

Operation: On July 7, 1925, the lumbosacral region was explored. The pathology as described in the *x*-ray was noted except, because of the marked rotation of the fifth lumbar vertebra, the articular processes were absent and there was no definite articular connection between the joint surfaces on the left, this making a very unstable articulation. A spine fusion was performed according to the Hibbs technique including the third, fourth, fifth lumbar and first sacral articulations. He remained on a convex frame for six weeks, after which he wore a jacket for one year, and then all support was discarded.

Re-examination on January 1, 1932, showed no deformity of the spine. There was a loss of motion in the operative area and he complained of no pain whatever, except that there was still a sensation of numbness about the lateral surfaces of the leg. Neurological examination at this time was negative.

CONCLUSIONS

1. Congenital defects of the lumbosacral joint are potential factors in the subsequent causes of low back pain.

2. The symptoms usually appear in the third decade of life.

3. Subjective distribution of the pain may involve or include the third lumbar segment to the third sacral segment but most frequently the fifth lumbar and first and second sacral segments of the spinal cord are involved.

4. No definite paralyses are noted in this series.

5. Elongated transverse processes of the fifth lumbar vertebra may be associated with other changes and defects in the lumbosacral joint which require repair. Excision alone of the transverse process would not be satisfactory.

6. Neurological study of back pain is indicated to exclude spinal cord tumor or radiculitis.

7. An attempt to explain the referred bizarre pains to the extremities is offered other than the compression of the spinal roots by narrowing of the vertebral foraminae.

8. Spine fusion with thorough removal of articular facets has yielded gratifying results.

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FORENSIC MEDICINE

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THE NATURE OF ALCOHOL TOLERANCE*

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IT is a matter of common observation that some individuals are able to imbibe many times the amount of alcohol that others can without showing the effects of drunkenness. Even in the same individual, at different times, the effects of the same quantity of alcohol vary.

The cause of tolerance to alcohol has long been a debated question. Many workers have tried to prove experimentally what is really the cause of alcohol tolerance. Rosenfeld[1] concluded that tolerance was due to more rapid oxidation. Reid Hunt[2] came to the same conclusion as a result of his work on the effect of methylcyanide on animals. Pringsheim[3] working with rats and rabbits, found that the alcohol excretion was about the same in habitues as in normal animals. He showed that the conjugated sulphuric acid was increased in habitues, but in too small an amount to have any bearing on tolerance. He cites Reid Hunt as having found it to be only 1 per cent of the total. Pringsheim[3] further showed that habitues burn up the alcohol much faster (two thirds of the time) than normal animals; that normal animals reach a 66 per cent higher alcoholic content in the blood than habitues; that the alcohol in habitues is burned not only in the liver, as it is in normal animals but also in the heart and in the brain; that normal animals oxidize the same amount of alcohol each hour, while in habitues the oxidation is accelerated each succeeding hour. Pringsheim states that the organs of both classes contain more alcohol than the blood, but that the ratio $\frac{\text{alcohol in organ}}{\text{alcohol in blood}}$ is much smaller in alcoholic animals because of more intense oxidation. The latter investigation also studied the absorption of alcohol from the gastro-intestinal tract, and found that normal animals absorb 20 per cent more alcohol in the first two hours than alcoholic animals do. The greater absorption and the lower oxidation he states, are the causes for the alcohol content of the body rising to a higher level in normal animals. During the succeeding four hours, Pringsheim found that the absorption in normal animals decreases to one seventh of the value of the first hour, and he gives this decreased absorption as the explanation for the rapid relative sinking of the alcohol content in normal animals, the prolonged period of absorption, and the reason for the much longer period that alcohol remains in the body of normal animals. As a result of his extensive study, Pringsheim concludes that tolerance is, to a great degree, due to

[1] Rosenfeld: Einfluss der Alkohols auf den Organismus, Wiesbaden, 1901.

[2] Hunt, Reid: Public Health Rep. U. S. Mar. Hosp. Serv., Washington, bull. 33, 1907.

[3] Pringsheim: *Biochem. Ztschr.* 12: 143, 1908.

*Contribution from the Chemical Laboratories of Chief Medical Examiner's Office, Bellevue Hospital, and of Washington Square College, New York University, New York City.

increased oxidative powers. J. Vahlmering[4] found that most of the alcohol is absorbed within the first hour; that it is about equally distributed in the various organs; that the brain receives it more slowly, but finally exceeds the other organs in alcohol content; and that all of the alcohol is not destroyed or excreted for a long period. Schweisheimer,[5] investigating the alcoholic content of the blood in human alcoholic and normal persons after they had partaken of alcohol, corroborated Pringsheim's results with animals. His results show that the maximum alcohol content is higher in normal persons; that it reaches this maximum in from one and one-half to two hours, remaining at this level for five hours, and then gradually diminishing, while in alcoholic persons it reaches its maximum more quickly, remains at this level for two hours, then subsides much more quickly. He found that normal persons get rid of all the alcohol in seven and one half hours, while alcoholic persons destroy it in about one half of that time. From his investigation, he concludes that tolerance is due to the decreased maximum alcohol zone, which depends on more rapid oxidation. Schweisheimer further states that he could find no proof that increased resistance toward alcohol comes into play. In a later paper, Schweisheimer[6] brings out an interesting and important point that in chronic alcoholic patients of a decade or more the tissues may lose the previously acquired oxidizing power, and that such persons may be as much affected by alcohol, if not more, than the abstainer. Gettler and Tiber[7] from investigations and analyses of 6000 human cases found that the effect produced by alcohol on all individuals, no matter what the previous habits, is proportional to the amount of alcohol present in the brain. They further state "It is true, however, that the same amount of alcohol consumed will affect different persons to a different degree. This, one must remember is alcohol consumed, and not the quantity of alcohol present in the brain. In those who have a greater tolerance, the power to oxidize alcohol rapidly has been developed to a high degree. They can partake of much more alcohol and show less effect because they destroy it much more quickly. Because of this more rapid oxidation, much of the alcohol consumed is destroyed, and hence it does not accumulate in the brain. The alcohol present in the brain is not proportional to the amount consumed by different persons, because the processes of oxidation in the cells vary. That part of the alcohol, however, which escapes oxidation and hence accumulates in the brain, has its effect, and it matters little as to what the alcoholic habits of the person have been." Gettler and Freireich[8] attempting to find a correlation between the alcohol content of the brain and the body fluids, showed that the blood-brain ratio is too variable and hence the blood cannot be used as an index of intoxication. They further showed that the spinal fluid-brain ratio was constant. The alcohol content of the spinal fluid was always in definite agreement with that of the brain, and therefore the alcohol content of the spinal fluid can be used as an index of intoxication in living people. The best experimental work to date, therefore, seems to show that alcohol tolerance is due to the ability of the cells to oxidize it rapidly. There is no evidence that decreased absorption, more rapid elimination or an acquired resistance by the cells may be the cause. In our experimental work, we have attempted to throw more light on the subject.

EXPERIMENTAL PART

For the purpose of our experiments, it was necessary to convert a number of animals into habitual alcohol drinkers.

[4] Vahlmering, J.: *Zentralbl. biochem. Biophys.* 14: 520, 1912.

[5] Schweisheimer: *Deutsches Arch. f. klin. Med.* 109: 271, 1912.

[6] Schweisheimer: *Schw. chem. Ztg.*, 1920, p. 524.

[7] Gettler & Tiber: *Archiv. of Path. & Lab. Med.* 1927, vol. 3, pp. 218–226.

[8] Gettler & Freireich: *J. Biol. Chem.*, 1931, vol. 42, pp. 199–209.

Dogs were chosen for the experiments in order to obtain brains that were sufficiently large to make determinations of the alcohol content feasible. Each dog was given his normal daily ration of food. During the first two days, all water was kept from them in order to have them very thirsty. Following this period of partial dehydration, a cool 2 per cent alcohol solution in water was placed into their fluid containers. The animals readily drank up to as much as a liter of the dilute alcohol solution per 24 hours. During the following two months, the alcohol content of their fluid intake was gradually increased to 30 per cent. Thereafter the alcohol concentration of their fluid intake was kept at 30 per cent. Each dog consumed about one liter daily, amounting to 300 grams of absolute alcohol. This treatment was continued for periods varying between six months and two years. The resulting chronic alcoholic dogs we designate as habitues throughout this paper, while those dogs that have never before partaken of any alcohol we will refer to as abstainers.

At first we attempted to ascertain by the ordinary crude method of observation whether there was any gross difference in the behaviours of habitues and abstainers, when both were given the same definite amount of alcohol. A habitue and an abstainer of about equal weight were selected. For a period of 24 hours both animals were kept without food and drink in order to rule out any variations in absorption of the alcohol, which might be caused by presence of food in the gastro-intestinal tract. Each animal was then given, by stomach tube, 150 cc. of 30 per cent alcohol. Within 30 minutes the abstainer became uncertain in his movements, staggered on attempting to walk, and swayed on trying to stand still. The habitue was as playful as ever. He showed no uncertainty in his movements.

The above experiment was repeated with another set of subjects. The quantity of alcohol was doubled; that is, each animal (habitue and abstainer) received by stomach tube, 300 cc. of 30 per cent alcohol. In 15 minutes the abstainer became very unstable, was staggering, and unable to carry out any purposive movements. After 25 minutes he lay down, did not respond to commands, was unable to rise. The habitue also showed effects of intoxication, but not to as marked a degree. After 25 minutes he became unstable but still walked around. When pushed over, he showed a loss of the usual alacrity in rising. After 55 minutes, he was lying down, but responded slowly when called.

The two experiments just described prove the long standing contention, that the same quantity of alcohol imbibed may affect different individuals to a different degree. A quantity of alcohol sufficient to cause drunkenness in an abstainer may not affect a habitue at all. It must be borne in mind however, that we are here talking of alcohol consumed and not alcohol found present in the brain.

A series of experiments were next conducted to determine the alcohol content of the brain, liver, blood and spinal fluid of the two types (abstainers and habitues) of animals, after they had been given varying quantities of alcohol by stomach tube and allowed to live varying intervals of time. We also determined in some of the experiments the amount of alcohol remaining in the gastro-intestinal tract of the animals, in order to determine how much of the alcohol given was actually absorbed into the organism proper. The procedure was as follows: In each set of experiments one habitue and one abstainer was used. The two animals selected were approximately of equal weight. During the 24 hour period preceding the beginning of the experiment all food and drink was kept from them. To begin the experiment, the quantity of alcohol decided upon, was given them by stomach tube. Following the administration of the alcohol, the dogs in the several sets of experiments were allowed to live varying periods as indicated in the tables. During these intervals their actions and movements were closely watched. The animals were placed into chambers, with glass windows for observa-

tion, and illuminating gas was let in. The time at which respiration ceased was noted. When dead, the animals were immediately autopsied. The brain, liver, blood, spinal fluid, were placed into clean containers, sealed and placed into the refrigerator. The contents of the stomach and the intestines were placed into a graduated cylinder. The stomach and intestinal walls were then carefully washed several times with ice water. These washings were then added to the original contents in the graduated cylinder. The combined volume of contents and washings were noted, put into a flask, corked, and kept in the refrigerator until analysis was started. The alcohol content of the brain and liver was determined by the method of Gettler and Tiber;[7] that of the blood, spinal fluid, and gastro-intestinal contents by the method of Gettler and Freireich.[8] Eleven sets of experiments were conducted. In order to avoid duplication of results, we are presenting only four of these eleven sets of experiments.

Set 1: experimental data

	Habitue	Abstainer
Weight of dog	10.68 kilos	10.03 kilos
Alcohol given (in 30% conc.)	45. gms.	45. gms.
Time between alcohol intake and death	45. min.	54. min.
Alcohol in brain	0.153%	0.284%
Alcohol in liver	0.155%	0.279%
Alcohol in blood	0.197%	0.319%
Alcohol in spinal fluid	0.225%	0.405%

The data of set 1 bring out the fact that although the two dogs were of the same weight, received the same quantity of alcohol, lived approximately the same length of time after the alcohol administration, still the organs of the habitue had much less alcohol present than those of the abstainer. Just before death, the habitue was perfectly normal in his behaviour, while the abstainer was definitely intoxicated. This corroborates the findings of Gettler and Tiber[7] that intoxication only results if the alcoholic content of the brain exceeds 0.25 per cent; and also the findings of Gettler and Freireich[8] that intoxication only results if the alcohol content of the spinal fluid exceeds 0.265 per cent.

Set 2: experimental data

	Habitue	Abstainer
Weight of dog	18.3 kilos	14.7 kilos
Alcohol given (in 30% conc.)	90. gms.	45. gms.
Time between alcohol intake and death	146 min.	147 min
Alcohol in brain	0.151%	0.128%
Alcohol in liver	0.127%	0.118%
Alcohol in blood	0.161%	0.142%
Alcohol in spinal fluid	0.205%	

At the time of death, neither of the dogs of set 2 was intoxicated. They both behaved in a perfectly normal manner. This is due to the fact that the alcohol content of the brain did not reach 0.25 per cent. The data of set 2 also show that although the habitue received twice as much alcohol as did the abstainer, the amount of alcohol found in the organs and fluids of the habitue were only slightly higher than those found in the abstainer, indicating a much lower accumulation of alcohol in the organs of the habitue.

Set 3: experimental data

	Habitue	Abstainer
Weight of dog	23.7 kilos	19.1 kilos
Alcohol given (in 30% conc.)	45. gms.	45. gms.
Time between alcohol intake and death	58 min.	62 min.
Alcohol in brain	0.109%	0.140%
Alcohol in liver	0.113%	0.143%
Alcohol in blood	0.110%	0.142%
Alcohol in spinal fluid	0.115%	0.147%
Alcohol left in gastro intestinal tract	6.83 gm.	8.37 gm.

Neither dog in set 3 showed any signs of intoxication during the entire experiment because the alcoholic content of the brain was well below 0.25 per cent. Although both animals received the same amount of alcohol, the organs and fluids of the habitue again contained less alcohol than those of the abstainer. That the lower alcohol content of the organs of the habitue was not due to a lesser absorption of alcohol

from the gastrointestinal tract was proven by determining the amount of alcohol left in the stomach and intestines. In the habitue 6.83 gms. of alcohol were left unabsorbed in the gastro-intestinal tract, while in the abstainer there remained 8.37 gms. The lower alcohol content in the organs of the habitue is therefore not due to decreased absorption.

SET 4: EXPERIMENTAL DATA

	Habitue	Abstainer
Weight of dog	25.9 kilos	20.5 kilos
Alcohol given (in 30% conc.)	114. gms.	114. gms.
Time between alcohol intake and death	62 min.	53 min.
Alcohol in brain	0.188%	0.349%
Alcohol in liver	0.182%	0.370%
Alcohol in blood	0.248%	0.415%
Alcohol in spinal fluid	0.225%	0.453%
Alcohol left in gastro intestinal tract	10.6 gms.	15.5 gms.

Although both dogs in set 4 received the same amount of alcohol, the abstainer, just before death, was deeply intoxicated, he could not be roused, while the habitue only showed the first signs of disturbed equilibrium. Again we perceive that when the alcohol content of the brain nears 0.25 per cent intoxication begins; and when much above this figure, deep intoxication results. The figures obtained in this set of dogs again confirm the fact that the organs of habitues contain much less alcohol than those of abstainers, although the same amount of alcohol was given each one. This decreased amount of alcohol in the organs of the habitue cannot be ascribed to a decreased absorption from the gastro-intestinal tract, because the analysis again revealed that the absorption was some what greater in the case of the habitue.

DISCUSSION

Four possibilities present themselves to explain the cause of tolerance to alcohol taken per os:

1. Decreased absorption from gastro-intestinal tract.
2. An acquired physiological (cellular) resistance to alcohol.
3. Increased elimination (conjugated or in free state) by kidneys, lungs and skin.
4. More rapid destruction by oxidation.

1. *Variations in absorption.* In order to avoid any variations in the absorption of the alcohol from the gastro-intestinal tract, no food was given the dogs for twenty-four hours previous to the beginning of the experiments. Furthermore, since the absorption of the alcohol from the gastro intestinal tract of the habitues was somewhat more complete than that of the abstainers, and since the habitues were less affected by a definite quantity of alcohol, therefore we conclude that absorption processes have no bearing on tolerance.

2. *Physiological resistance to alcohol.* When no explanation for tolerance to a certain substance is available, then the term "acquired resistance" is commonly used as a subterfuge.

The question of whether an acquired resistance by the cells to alcohol plays any part in tolerance has been studied by several investigators. No evidence favoring this view has ever been presented. Schweisheimer[5] after intensive investigation on this point, states that he could find no evidence that increased resistance plays any part in alcohol tolerance.

In our own series of experiments we found without exception that the physiological condition of the animal seems to run parallel with the amount of alcohol in the organs (especially the brain and spinal fluid). If acquired resistance was the cause of tolerance, then the picture obtained from the analyses should be quite different. There would be no constant relationship between the alcoholic content of the brain and the physiological behaviour, such as we constantly found. We should meet subjects in which the alcoholic content of the brain was quite high and yet no physiological disturbance was noticed. In all our experiments no such cases were found. As a result of our experimental investigation, we adhere to the views of Rosenfield,[1] Pringsheim,[3] Schweisheimer,[5] that tolerance to alcohol is not due to an

acquired resistance of the cells to alcohol.

3. *Increased elimination by kidneys, lungs or skin.* That elimination or excretion of the alcohol plays a negligible role in tolerance has been shown by many investigators. Pringsheim[3] found the excretion of alcohol to be about the same in habitues as in abstainers. He further found that although the conjugated sulphuric acid in the urine was slightly increased in the case of habitues, the amount of increase was too small to have any bearing on tolerance. Pringsheim cites Reid Hunt as having found the increase to be only 1% of the total. Cushny,[9] from animal experiments, states that following the injection of a small quantity of alcohol, only traces are excreted by the lungs. Bödlander,[10] in experiments on dogs and on himself found less than 2 per cent excreted by the lungs, after large doses of alcohol had been given. Miles[11] after an extensive study on the subject of alcohol in the urine, found that only 1.5 per cent of the amount of alcohol ingested was excreted during the first two hours, and only 0.3 per cent during the following six hours. Atwater and Benedict[12] noted that only one to two per cent of the imbibed alcohol is excreted through the lungs, kidneys and skin.

The amount of alcohol excreted through lungs and kidneys moreover, is proportionate with the alcohol concentration in the arterial blood circulating through these organs. A study of the figures presented in our experiments, showing a smaller concentration in the blood of habitues than in abstainers, reveals that differences in elimination must necessarily be too small to have any effect on tolerance to alcohol. Moreover, the difference, if any, is such as to cause a smaller elimination on the part of the habitual drunkard.

4. *More rapid destruction (oxidation).* The investigations of Rosenfield,[1] Reid Hunt,[2] Pringsheim[3] and Schweisheimer[5] all point to the view that habitues are more tolerant to alcohol than abstainers, because their organisms have acquired the power to burn up the alcohol more rapidly.

In our experiments we have found without exception, that those animals which show a greater tolerance to a definite amount of imbibed alcohol, always have a lower concentration of alcohol in their organs. Since differences of absorption of alcohol from the gastro-intestinal tract and excretion by lungs, and kidneys, play a negligible role in producing the lowered alcohol content in the organs of habitues, same must be due to a more rapid destruction or oxidation of the alcohol.

[9] Cushny: *Jour. Physiol.* 1910, vol. 40, p. 17.

[10] Bödlander: *Archiv. f. d. ges. Physiol.* 1883, vol. 32, p. 398.

[11] Miles, W. R.: *Jour. Pharm. & Exp. Therap.* 1922, Vol. 20, p. 265.

[12] Atwater & Benedict: quoted by Himwich, Alcohol & Man. 1932, p. 8, Macmillan.

SUMMARY

1. Dogs were converted into chronic alcoholics (habitues) by daily imbibition of alcohol, for periods ranging between six months and two years. The effect of definite amounts of alcohol, given per os, on habitues was observed and compared with the effect produced on normal dogs (abstainers). Differences in the alcohol content of the brain, liver, blood, spinal fluid and gastro intestinal tract of habitues and abstainers, were also studied.

2. In all cases (whether habitue or abstainer) intoxication (disturbed equilibrium) sets in when the alcoholic content of the brain reaches 0.25 per cent.

3. Following the administration of definite amounts of alcohol, our experiments without exception revealed a smaller alcoholic content in the tissues and body fluids of the chronic alcoholic dogs as compared to the normal dogs.

4. The smaller concentration of alcohol in the organs of the habitue is not due to decreased absorption from the gastro-intestinal tract nor to increased elimination by lungs or kidneys.

5. Increased destruction (oxidation) of the alcohol by the tissues, is the cause of the smaller accumulation of alcohol in the organs.

6. Increased tolerance to imbibed alcohol is due to more efficient oxidation of the alcohol by the tissues.

ACCIDENTAL STAB WOUND OF BLADDER, SELF INFLICTED

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WOUNDS of the bladder are relatively frequent owing to the extensive injuries of the pelvis and spine due to automobile accidents. Bladder wounds due to sharp instruments are, on the other hand, relatively infrequent. Rupture of the urethra often accompanies bladder injury. Injuries from within due to instrumentation and injuries from without as in accidental opening of the bladder in an operative procedure are also not uncommon. In looking through the literature of injuries of the bladder by external violence, aside from the factors mentioned, little can be found. R. C. Graves in "Lewis' Surgery" states that there is no record of a stab wound by a bayonet. Young in his resume of injuries to the bladder during the late war also makes no mention of any such case or similar case. The writer found no report of a case in which a stab wound of the bladder occurred without injury to other viscera. Because of this it seems worth while to report the following case:

J. S., a meat cutter, aged twenty-seven, was cutting bacon at 4 P.M., February 17, 1933. He placed a slab of bacon on the block and took a skinning knife with a 6 inch blade in his right hand with the handle pointing toward the thumb. Holding the bacon with the left hand, he cut through the slab, pulling the knife toward himself. The force used was such that he severed the meat and buried the end of the knife in his abdomen. The wound bled profusely and a physician was immediately called who examined the wound and stopped the bleeding by packing with gauze. The patient's condition was excellent, he showed no abdominal tenderness and was not at all shocked. He was, however, taken home but did not go to bed.

At 7 P.M., he attempted to void and when he strained there was a gush of fluid from the abdominal wound forcing the packing out. He also voided by urethra. He became frightened and immediately called his physician, who sent him to the hospital.

On admission the patient's temperature was 100⅗° F., rectally; pulse 116; respirations 24. He was badly frightened but careful examination revealed nothing aside from tenderness over the entire suprapubic region which was most marked over the lower right rectus and inguinal regions. Auscultation revealed no signs of abnormal peristalsis. There were no signs of internal hemorrhage. There was a half inch cut, 3 inches below the umbilicus over the right rectus muscle. Pressure about the wound caused no bleeding and no urine could be expressed through this incision. The patient was then catheterized and the urine found to be slightly tinged with blood. The bladder was then filled with boric acid and he was permitted to sit up and void. On straining in the upright position, fluid welled up from the suprapubic wound. A diagnosis of perforation of the bladder, extraperitoneal, was made and immediate operation advised. It was felt that the patient had had a distended bladder and that the perforation was limited to that organ.

Operation was performed under spinal anesthesia using novocaine crystals 150 mg.

A right rectus incision directly through the wound was made. The subcutaneous tissues were deeply infiltrated with blood, but no definite bleeding was encountered. On incision of the fascia it was noted that the rectus was almost completely cut transversely and the ends retracted. The muscle and the supravesical region were

also infiltrated with blood with some large clots but no active bleeding. The wound in the bladder could not at first be found, but on sliding the finger forward, it was located just above the symphysis. The opening admitted the tip of the small finger. The edges were seized with Allis clamps and the bladder pulled up into the wound. There was a small amount of blood-stained urine in the bladder but no signs of any other wound. Careful examination showed no apparent opening into the peritoneal cavity. The bladder wound was closed with interrupted sutures of No. 1 chromic catgut and the suture line inverted with a second layer of continuous chromic catgut. The clots of blood were removed from beneath the muscles and a cigarette drain placed in the space of Retzius. The bladder was then fastened to the overlying muscles. The muscles and the fascia were sutured with interrupted chromic catgut. The operative area was also flooded with 2 per cent mercurochrome. Interrupted dermal suture was used for the skin. The drain was led out through the lower end of the incision. A retention catheter was placed in the bladder through the urethra. The blood pressure during the procedure varied between 130 and 150 systolic. There was no nausea or vomiting.

The patient's convalescence was complicated by a late infection of the wound. There was a constant drainage of dark clotted blood alongside the cigarette drain at first which apparently was blood that had been forced into the tissues at the time of the accident. The whole right suprapubic region extending down over the femoral area and above the right iliac crest was markedly discolored. On the seventh day the inlying catheter was removed. The following day the patient noted that when he voided there was a small amount of purulent material oozing from the wound, which was now showing signs of low grade infection. The wound remained the same until the nineteenth day. At this time he showed a rise of temperature with signs of cystitis and right pyelitis. The wound in the bladder opened up and urine drained into the dressing. He received bladder irrigations of potassium permanganate 1:10,000 daily and later alpine light to the wound. The wound slowly granulated in and was entirely healed at the time of discharge, March 17, 1933, one month after admission.

The urine showed a moderate amount of albumin and much pus, but was otherwise normal. Urinalysis on March 17 still showed much pus and a heavy cloud of albumin and many bacteria.

He was sent home and advised to take it easy. Bladder irrigations were discontinued but he complained of so much burning and frequency that they were again given every two days. During his stay at home he developed a pyelitis on the left side, but this cleared up with rest in bed and forcing of fluids. During the first part of April the urine became almost clear and his symptoms were restricted to nocturia two or three times with occasional pain on voiding. On April 27, 1933 all medications were discontinued and the patient was cystoscoped. At this time his general condition was markedly improved but he was still underweight and felt weak.

The bladder showed a moderate amount of congestion about the ureteral orifices, more marked on the left. The trigone also showed some congestion. Examination of the fundus of the bladder was normal aside from a scar approximately ½ inch long on the right anterior roof. This scar was clean and was surrounded by normal bladder mucosa. A No. 7 catheter was passed to both pelves without difficulty and specimens obtained. These showed no growth on culture. Kidney function: P.S.P. was normal: 3½ min. left, 4 min. right intravenously." Laboratory examination: R.B.C. 4,020,000; hemoglobin 65 per cent; N.P.N. 28.5; B.U.N. 14.2; Urinalysis: cystoscopy specimens: left kidney: Few red blood cells, many white blood cells, many round epithelial cells; right kidney: few

red blood cells, few white blood cells, many round epithelial cells, no casts.

Following the cystoscopic examination the patient had pain over the right kidney region with frequency and dysuria with temperature of 101.5°. This cleared up within twenty-four hours. Convalescence was otherwise normal, although protracted due to the recurrent attacks of pyelitis.

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CASE REPORTS

LEIOMYOSARCOMA OF THE UTERUS*

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"LEIOMYOSARCOMA is a tumor composed chiefly of relatively histologically mature but physiologically immature unstriped muscle cells that have undergone sarcomatous changes." The type of tumor under consideration is also referred to by various pathologists as leiomyoblastoma, leiomyosarcoma, myoma malignum and highly cellular myoma (Danreuther[1]).

Miller and Rogers,[2] in a fairly comprehensive review of the subject, find that the majority of observers report from 0.5 to 2 per cent of myomata showing sarcomatous changes. They conclude from an extensive study of cases reported by various clinics that 1 per cent is a fairly representative figure of the occurrence of sarcoma in the uterus.

According to some observers myosarcoma of the uterus may take its origin from the various tissue components of the uterus or a fibroid, such as the interstitial tissue, from the muscle cells, from the wall of the blood vessels. This opinion is not substantiated by Danreuther,[1] Ewing[3] and others, who put the histogenesis of sarcoma definitely as an unstriped muscle cell tumor.

The various classifications of uterine sarcomata and the confusion as to the malignant or non-malignant nature of these tumors is probably due to the lack of agreement as to the origin of uterine sarcoma and the criteria of malignancy as applied to it, as well as to the individual interpretation of the cellular picture by the various pathologists. According to Ewing,[3] who gives the best description of these tumors:

> Too much importance has been attached to variations in cell forms, and too little to histogenesis and gross anatomy. . . . The structure of uterine sarcoma is extremely varied. . . . It is well known that the malignancy varies with the cell type, reaching the acme in round-cell and giant cell structures, but it has repeatedly been shown that in the same tumor the structure of different portions may exhibit several cell types, and that different tumors illustrate all transition phases of smooth muscle cells to round cells and giant cells. Even in well-formed fibromyomas, areas of round-cell sarcoma may occur.

It is Ewing's opinion that there is not sufficient evidence to show that these tumors arise from any fibroblastic elements, on the contrary there is little doubt that the entire group is essentially of myogenic origin.

A number of these highly cellular tumors and even those that come up to the criterion of malignant tumors do not show definite metastasis and we have no means of determining the length of time this tumor has existed prior to removal by operation. Nor do we have any means of determining if the actively malignant leiomyosarcoma has existed in a quiescent state, before it assumed malignant qualities. From a study of literature it is safe to suppose that the leiomyosarcoma of the

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uterus may show microscopically all the features of a malignant growth without the malignant qualities. For some reasons, at the present unexplained, the tumor breaks the friendly relations with its immediate surroundings and spreads either locally or to distant foci such as lungs, liver, kidney, etc. Fortunately for the host such breaks in friendships occur very rarely.

Table 1 showing the ordinary microscopic criteria of uterine sarcomata as given by Evans[4] for leiomyosarcoma is contrasted with those of myoma:

TABLE 1
MICROSCOPIC CRITERIA OF UTERINE SARCOMATA (EVANS)

Leiomyosarcoma	*Myoma*
1. Increase in size of cells.	1. Cells and nuclei more uniform in size.
2. Shorter and plumper cells with oval or vesicular nuclei.	2. Long oval nuclei. Cells and nuclei exhibit more evenly rounded ends.
3. Inequality in size and irregularity in shape and arrangement.	3. The cross section shows muscle bundles with nuclei embedded in acidophile fibers alternating with longitudinal sections. This is quite characteristic.
4. Lack of differentiation.	4. The connective tissue stroma is a cellular, often edematous or infiltrated with round cells.
5. Unequal and deep staining of nuclei.	5. Typical arrangement of cells.
6. Large cells with occasional multiple nuclei.	6. Many adult collagenous fibrils running between cells.
7. Mitotic figures.	7. Less vascular.
8. Decrease or absence of stroma.	
9. Thinness and absence of vessel walls.	
10. Less acidophilic character of cell cytoplasm. (added)	

Evans further grouped his cases according to malignancy by counting the mitotic figures in 1 cu. mm. of tumor:

1—2200–12,000 per cu. mm.
2—200–800 per cu. mm.
3—0–few per cu. mm.
Group 1—highly malignant
Group 2—borderline
Group 3—premalignant

Even with these criteria as a guide there are still a number of tumors in the uterus which will be difficult to classify as to its malignant or non-malignant tendencies. Clinically, the sudden and rapid increase in size of a long quiescent uterine growth, signs of local or distant invasion, cachexia, ascites usually signify a malignant degeneration.

It is apparent from the foregoing and a study of the reported cases that leiomyosarcoma of the uterus is a tumor definitely arising from unstriped muscle cells. It is also apparent that there is no unanimity in the classification of these tumors either by the clinician or by the pathologist. In order to clarify this situation the following is suggested: All tumors exhibiting the microscopic criteria of malignancy, as defined by Evans[4] are to be considered as leiomyosarcoma. Because this growth does not conform to the nature of the ordinary malignant tumors, namely, that the malignancy of the tumor corresponds to the histological picture, it is further suggested that those tumors not showing clinically any evidence of malignancy should be designated non-metastasizing leiomyosarcoma, while the clinically malignant leiomyosarcoma should be classed metastasizing leiomyosarcoma. Recurrent leiomyosarcoma shall be applied to the type of tumor which usually occurs in the cervix or broad ligament of the uterus and which recurs locally after removal.

Leiomyosarcoma may occur wherever unstriped muscle is found. A case of "malignant myoma with Meckel's diverticulum" is reported by Symmers[5] and a very interesting case of leiomyosarcoma in the bladder is reported by H. Krauskopf.[6] Symmers mentions the occurrence of malignant myoma in the stomach, intestines, and gall bladder. The microscopic picture in these extra-uterine tumors is very similar to that of uterine origin.

Bunten,[7] Farr,[8] and Kasman[9] report cases of leiomyosarcoma under different pathological designation. They come to the conclusion that there is no clinical evidence to predicate the existence of this tumor in the uterus except when the tumor is frankly malignant with invasive characters and metastasis.

Meaker[10] considers leiomyosarcoma as occasionally found at operation a histo-

logically malignant tumor; clinically, it is only potentially so. He believes that in practice the attempt to differentiate between histological and clinical malignancy is unsound, in spite of the fact that the leiomyosarcoma is an exceedingly uncommon cause of death.

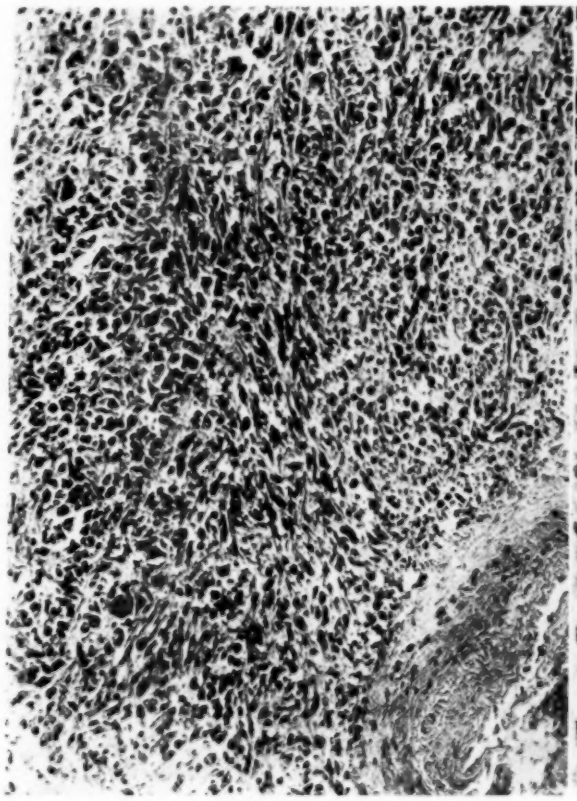

Fig. 1.

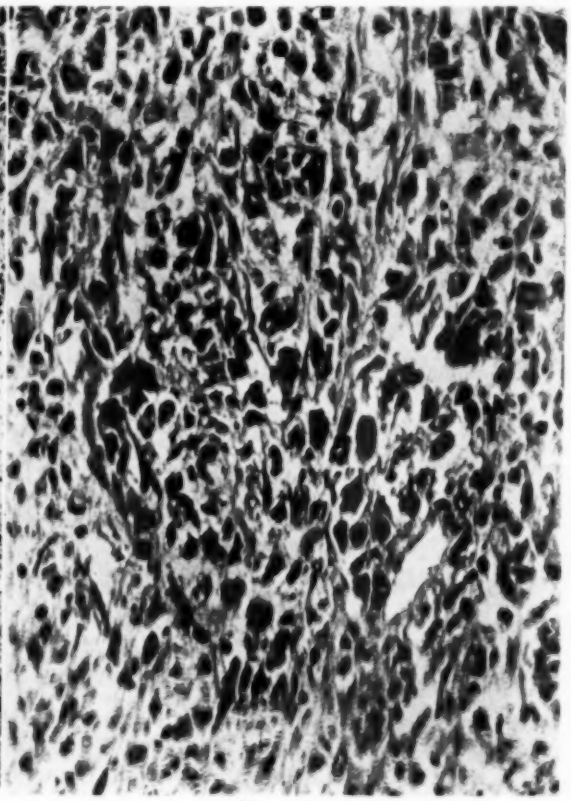

Fig. 2.

Fig. 1. Very cellular portion of tumor, quite vascular; individual cells show great anisocytosis, nuclei are very large, reducing amount of cytoplasm to almost nil; nuclei are very hyperchromatic; several mitotic figures are seen.
Fig. 2. Same as Figure 1, under greater magnification; nuclear hyperchromatism and cellular anisocytosis are well brought out.

Schriener,[11] in an analysis of 1205 cases of tumors of the uterus during a period of fourteen years, has found 8 cases of malignant myoma. He concludes from his study that the end-results in these 8 cases are poor and that operative treatment is inadequate; that malignant myoma may occur in any decade and that there are no pathognomonic symptoms of this disease. In the only patient who was well four years nine months after the operation, radiation treatment was used.

Leiomyosarcoma of the uterus may occur in any decade but is particularly prone to develop at menopause. According to Frank,[12] about 25 per cent of leiomyosarcoma of the uterus occur in nullipara. There are no pathognomonic signs or symptoms of leiomyosarcoma of the uterus unless it is the metastasizing type, but a watery or blood-tinged vaginal discharge, bleeding, menorrhagia and metrorrhagia should call one's attention to the possibility of malignancy. Pain in the tumor independent of menstruation should also lead to a suspicion of malignancy (Bunten[7]).

The macroscopic appearance of leiomyosarcoma can be recognized only if the malignant changes are well marked.

Grossly the tumor resembles fibromyoma. Certain macroscopic features of leiomyosarcoma have been described: (1) lack of demarcation with difficulty in shelling out from the uterine wall; (2) white to grayish in color with opaque and luster-

less appearance on cut surface; (3) areas of degeneration such as hemorrhage, cyst formation and myxomatous changes will give the tumor a mottled appearance; (4) vascularity and irregularity of the sparse fasciculi; (5) if the tumor is rapidly growing it may resemble brain tissue; (6) friability of the tumor.

Meaker,[10] who tried to apply the foregoing in recognizing leiomyosarcoma at operation, failed. Three cases diagnosed by him as malignant proved benign and 2 cases passed as benign proved histologically malignant.

The mixed tumors of the uterus are rare and form an interesting chapter in themselves. Their origin has not been determined. Wilms considers them as arising from embryonal rests in the Wolffian ducts. Von Hansemann believes that the stroma of a cancer becomes sarcomatous. It is interesting that the metastasis from a mixed tumor may show the same complex nature. In the case of Kubinyi's, quoted by Frank,[12] the bone metastases were sarcomatous, those of the soft parts carcinomatous.

A case of leiomyosarcoma came under our observation at Harlem Hospital.

CASE REPORT

H. W., a colored woman, forty-two years of age, housewife, was admitted to Harlem Hospital, July 25, 1931, from the Out-Patient Department.

History. Always well, married fifteen years, no pregnancies, menstrual periods regular, four day type, moderate bleeding, no pain. With the onset of the June period, one week late, patient had moderate pain, passed blood clots and the period lasted eight days instead of the usual four days. About one week prior to the last menstrual period, patient experienced morning nausea and vomited several times.

In July, one month prior to admission, the patient developed a productive cough which was blood-tinged on several occasions. She experienced chilly sensations and felt feverish at times. On July 4, the patient began to bleed per vaginam. This was accompanied by bearing down pains along both flanks. The condition prevailed irregularly up to the time of admission. She had also noticed a progressive weakness and a loss of weight during the past two or three weeks in spite of the gradual increase in size of her abdomen. Urination became frequent but there was no dysuria.

Physical Examination on admission, July 25, 1931: Fairly well-nourished colored female, slightly anemic, not in pain, not acutely ill. Heart normal; lungs, some rales irregularly distributed. Abdomen flaccid; the lower half of the abdomen is occupied by a tumor globular in outline to within one finger of umbilicus. This mass is slightly movable, non-painful, but has not the hard feel of a fibroid. Liver and spleen not palpable. Inguinal and femoral nodes not enlarged.

Vagina showed a bluish colored mass, devoid of mucous membrane, which extends from the left fornix to the outlet narrowing the latter. The cervix is normal in size and appearance and is pushed upward to the right.

Bimanual examination reveals a narrow vaginal orifice with left-sided growth as already described. A large mass replaces the uterus; it is slightly movable and fairly soft, not painful or tender.

Diagnosis: Chorionepithelioma of uterus with vaginal and probably pulmonary metastasis.

Blood Examinaion: R.B.C. 3,800,000; Hg. 60 per cent; W.B.C. 12,400; polymorphonuclears 75 per cent; lymphocytes 21 per cent; transitional cells 4 per cent.

X-ray of the chest on admission showed lung studded with shadows 1–3 cm. in diameter of a definitely metastatic character.

In view of the morning nausea, delayed menstrual period of July with passing of clots and prolonged period afterwards, it was assumed that patient was pregnant and aborted.

The blood-tinged sputum, signs in lungs, *x*-ray films showing definite metastasis and a rapidly growing tumor in the pelvis led us to believe that we were dealing with a chorionepithelioma with metastasis in lungs. However, the Aschheim-Zondek test was negative.

At laparotomy, August 4, 1931, the uterus was found pearly grayish, tremendously enlarged to about the size of seven months' pregnancy, with the small intestine and bladder adherent to it by fine recent and old adhesions. There were two spontaneous perforations in

the anterior wall of the uterus at the left cornu through which cauliflower friable villi protruded. Extensive infiltrations of both broad ligaments. An attempt to do a hysterectomy was abandoned. Findings at the laparotomy did not alter our opinions.

Pathological report July 14, 1931, Dr. Weintraub; Gross: specimen consists of several pieces of tissue said to come from the uterus. The tissue is of soft consistency and grayish white in color. Markedly edematous. One piece is hemorrhagic.

Microscopic: Examination shows a leiomyoma which has undergone malignant degeneration. There are giant cells, and broad sheaths of muscle cells with mitotic figures and pronounced eosinophilia.

Diagnosis: Malignant leiomyoma (leiomyosarcoma).

The pathological report of the Out-Patient Department biopsy agreed with the specimen removed at operation. Unfortunately it was reported after the patient was subjected to laparotomy.

The patient ran a comparatively uneventful course. The wound healed per primam. She left the hospital of her own accord on the 18th, but she was readmitted two days later with her symptoms very much aggravated. The leiomyosarcoma was apparently spreading rapidly as evidenced by the size of the abdominal mass and lung signs. Several days later the patient was transferred to the New York City Cancer Institute where she died on September 4, 1931.

It is interesting to note that the biopsy specimen (the same slide at the Cancer Institute) examined by two competent pathologists was diagnosed as "diffusely growing epithelioma of the spindle and squamous cell type" by one and "sarcoma of the spindle cell type or as fibro-myxo-sa" by the other.

The correct treatment of leiomyosarcoma is a matter for the future. We have no published data on the subsequent course in the cases of leiomyosarcoma non-metastasizing (new classification).

Meaker[10] and Wolfe[13] discuss the treatment in general and agree that a hysterectomy followed by radiation therapy is the method of choice.

Schriener[11] found that of the 8 cases of metastasizing leiomyosarcoma (new classification) treated by him (hysterectomy followed by radiation therapy) only one patient was well clinically five years later.

SUMMARY AND CONCLUSIONS

1. Leiomyosarcoma of the uterus occurs more frequently than is generally suspected.

2. It may occur in any decade but occurs most frequently towards the menopause.

3. There are no pathognomonic signs or symptoms of this disease.

4. Operative removal, once the disease has shown malignant characters, is followed by recurrence.

5. A careful follow-up is necessary to determine if the chance pathologic finding of leiomyosarcoma non-metastasizing recurs after hysterectomy.

6. The proper treatment is hysterectomy followed by radiation therapy.

7. Any rapidly growing fibroid tumor in the uterus should be suspected of leiomyosarcoma.

8. Leiomyosarcoma is definitely a tumor of myogenic origin.

9. A simple classification of these tumors is offered.

10. An interesting case of a leiomyosarcoma malignum of the uterus is reported.

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IDIOPATHIC SPASTIC ILEUS

WITH FATAL TERMINATION*

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CHICAGO

THE idea that spastic contraction of the intestinal musculature may obliterate the lumen of the bowel for varying periods of time and thus cause symptoms of intestinal obstruction was first conceived late in the nineteenth century. Murphy, in 1896, published his observations at operation of a spastic occlusion in a patient suffering from lead colic. Spastic ileus attracted little attention, however, until 1897, when Heidenhain, in a paper before the thirty-seventh congress of the German Surgical Society, attempted to prove that this form of obstruction constituted a nosological entity. Heidenhain's view was met with considerable opposition by a number of his contemporaries who declared that in their respective surgical practices they had never met the described condition. In spite of the opinions to the contrary, the conception of spastic ileus gained wider and wider acceptance, and in 1902, when Langemak reported 12 cases, only 2 of which were proved at operation, the entity became well established. Collected reports were published successively by Fromme (1914), Matthews (1915), Sohn (1920), and Nagel (1921), the latter gathering 51 instances of spastic ileus. Körte was able to accumulate, up to 1926, 28 cases of spastic ileus from his own records. The latest comprehensive publication on spastic ileus is that by Zimmerman (1930), who lists 157 cases to which the author adds 2 of his own, bringing the total up to 159.

Generally speaking, spastic ileus is looked upon as a medical rather than a surgical affection. If laparotomy is performed for symptoms and signs of intestinal obstruction and no organic cause is found, an error in etiologic diagnosis is assumed. Operation it is felt accomplishes nothing more than vizualization of a contracted, spastic segment of bowel, which may or may not relax during the period of direct inspection. The operation is almost invariably concluded as an exploratory, the surgeon being satisfied that the patient will recover. It is not generally appreciated that spastic ileus is not uniformly benign and that an enterospasm may persist even to the point of death. In these cases a most painstaking search at autopsy fails to disclose any cause of the persistent obstruction, on which account a neurogenic origin is assumed. It is these fatal cases of spastic obstruction with which relatively few are acquainted that we desire to treat in the discussion to follow.

In a survey of the literature 15 cases of idiopathic neurogenic spastic ileus terminating fatally were encountered. To this number can be added one of our own. The pathological changes in the 16 cases can be summarized as follows: The enterospasm involves segments of either the small or large bowel, or both divisions. Usually the spasm is noted in one location but occasionally many isolated segments are found to be constricted simultaneously (see Strehl). Generally only a few inches of bowel are affected although in some cases the involvement extends over a considerable length. As in one instance the entire large bowel may be universally contracted.

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A common location is found to be the lower portion of the ileum, but other parts of the small intestine are affected also. The involved segment of bowel generally presents a striking appearance being contracted to the maximum, white, bloodless, of about the diameter of a little finger or a pen and very firm. At times, merely collapse of the bowel is observed. When firmly contracted, the spastic segment ends abruptly at either or both ends as though tied by a cord. The proximal loops of bowel are generally distinctly distended whereas the distal segments are either moderately distended or normal in caliber. Occasionally the proximal portion, in addition to being distended is also hypertrophied (see Biernath). In a few cases the enterospasm persists during deep anesthesia while in some it is found even at autopsy! In some instances the spastic bowel is seen to return to a normal state while the abdominal organs are being inspected and in others relaxation appears to follow manipulation. In some cases no point of constriction but merely distended bowel is found. When a contracted segment is encountered, compression of the proximal, distended bowel results at times in passage of fluid through the constricted segment. Rarely the spasm intermits during operation as in the case described by Pendred. Dilatation of the stomach accompanies the distension of the intestine in but a few cases.

For purposes of this paper the reported cases with fatal outcome have been divided into three groups according to the evidence offered. The first group includes those cases in which the diagnosis of spastic ileus was established at operation only. The second group comprises the instances in which the presence of a spastic obstruction was determined at autopsy alone. In the third group are the cases in which the diagnosis was made at operation and subsequently confirmed by necropsy. Three cases belong to the first group. In the second group are 5 instances, including one observed by us. In the last and most informative group are included 8 cases.

GROUP 1. SPASTIC ILEUS WITH FATAL OUTCOME; DIAGNOSIS ESTABLISHED AT OPERATION ONLY

Case I. (Engstad.) A twenty-six year old man was admitted to the hospital with intense epigastric pain and almost incessant retching and vomiting. The pain began while the patient was at work and was so sharp that it almost made him faint. Tympanites developed overnight. Laparotomy revealed a coil of upper jejunum to be enormously dilated and to end abruptly in a small, whitish, band-like stricture. While being handled the band suddenly disappeared and became transformed into a segment of normal bowel. Following the operation the patient continued to suffer intense agony and died twenty-four hours later. Autopsy was not performed.

Case II. (Manion.) A child of thirteen months became suddenly ill with vomiting of a black material and subsequently developed obstipation and drowsiness. Irrigation of the bowel, castor oil, and small doses of calomel were given but only one bowel movement was effected. At operation, thirty-six hours after onset no organic obstruction was found. However, the small intestine was found to be dilated in the upper and collapsed in the lower portions. The contents of the dilated loops could be readily forced into the collapsed segments. The child died ten hours following operation. No post-mortem examination was held.

Case III. (Matthews.) A nine year old girl became ill with headache and malaise followed in two days by vomiting. Calomel and enemas failed to produce a bowel movement. On the third day of her illness the child developed paroxysmal cramps. Enemas, atropine, and hot fomentations afforded no relief. Laparotomy revealed about 4 inches of the ileum to be contracted down to the size of a little finger, the spastic portion beginning abruptly as though a ligature were tied about the bowel. There was distention of the proximal segment. Moderate compression of the latter forced gas into the collapsed bowel. The child died within a few hours. Autopsy was not permitted.

GROUP 2. SPASTIC ILEUS WITH FATAL OUTCOME; SPASTIC OBSTRUCTION DETERMINED AT AUTOPSY ALONE

Case IV. (Manion.) An infant of ten months became ill with vomiting of a black material

and severe constipation. Two days later, when seen by a physician, the baby was in collapse. It died on the third day of illness. Autopsy revealed the stomach and upper intestine to be distended and filled with a thin, black fluid. The ileum was collapsed. No organic obstruction was found.

Case v. (Manion.) An infant, six months of age, was ill for two days with severe constipation and vomiting of a dark material. Medical treatment after this time failed to relieve the baby who died on the fourth day of its illness. At autopsy the stomach, duodenum, jejunum and upper ileum were found to be normal. Approximately 2 feet of the lower ileum was markedly distended and filled with a dark material similar to the vomitus.

Case vi. (Voisin.) A young, hysterical girl became ill three times with intestinal obstruction. Twice recovery followed the administration of antispasmodics and purgatives. The third time, however, medical measures were ineffectual and the patient died. At autopsy only a spastic narrowing of the intestine could be found.

Case vii. (Schmid.) A thirty year old woman complained for four weeks of abdominal pain, obstinate constipation, vomiting and loss of weight. Physically pallor, emaciation and resistance in the lower abdomen were noted. A tuberculous peritonitis was considered and an *x*-ray with barium meal ordered. The roentgen examination showed the stomach displaced to the right and a delay in emptying of the small intestine. An incomplete obstruction was diagnosed and operation contemplated. However, early the next day, the patient died before laparotomy was instituted. At autopsy there was found distention of the entire small intestine and also of the colon down to the splenic flexure. The latter was firmly contracted. No cause for this spastic constriction could be established.

Case viii. (Steigmann and Singer.) See case report below.

Group 3. Spastic Ileus with Fatal Outcome; Diagnosis Made at Operation, Confirmed by Necropsy

Case ix. (Fromme.) A three and a half months old child came to the clinic with symptoms of an ileocecal intussusception. Laparotomy was performed and disinvagination done. Notwithstanding the operation the symptoms of ileus persisted and the child died. Autopsy revealed distention of the stomach, duodenum and proximal intestine with contraction of the lower half of the small gut. The cecum and ascending colon were of normal caliber but the remainder of the large bowel was narrow and firmly contracted. The author assumed a persistent spasm continuing even after the operation and leading to death.

Case x. (Heidenhain.) An old man complained of severe constipation for twelve weeks. Carcinoma of the rectum was considered and laparotomy undertaken. At operation string-like contracted loops of small intestine with dilatation of the proximal loops were found. The descending colon was distended. An enterostomy was done, but nevertheless the patient died two days after the operation. The autopsy revealed no changes in the intestine except a relatively insignificant, benign rectal stricture.

Case xi. (Körte.) A seventy-five year old woman came to the hospital with intestinal obstruction of four days' duration. The diagnosis of tumor or strangulation was made and a cecostomy performed. It was not until the eighth postoperative day that any fecal discharge through the cecostomy appeared. No bowel movement per rectum occurred during this time. Eight months later a laparotomy was performed. Careful examination of the entire intestine disclosed no tumor or any other mechanical obstacle but merely string-like contractions of the colon especially of the sigmoid portion. Cecosigmoidostomy had no alleviating effect upon the obstruction and on this account an ileostomy was performed eleven days later. The patient died eight days following the ileostomy. At autopsy no sign of peritonitis nor bowel obstruction could be found.

Case xii. (Nordman.) A sixty-six year old woman who had been having mild, colicky pain in the abdomen for eight years was brought to the hospital after being acutely ill for four days with severe abdominal pain, vomiting and obstipation. The abdomen was found to be markedly distended and tender to touch. Several loops of bowel were rendered prominent but no active peristalsis was visualized. Laparotomy revealed a segment of lower ileum 10 cm. in length which was firmly contracted and a marked dilatation of the proximal loops. The patient died and at autopsy no change

other than distended loops of bowel was found.

Case XIII. (Pendred.) A woman, fifty-seven years of age, suffered from colicky pain, vomiting and diarrhea alternating with constipation beginning in 1901. The ailment proved refractory to medical treatment. By 1905 the patient had become emaciated and bedridden and required morphine for control of the pain and vomiting. Peristaltic waves became visible, the vomiting assumed a stercoraceous character and hiccough developed. Laparotomy showed the small intestine to be distended up to a certain point beyond which the dilatation suddenly ceased and the bowel was flat, pale and lacked tonicity. While observing the intestine it began to fill out again and assume a normal appearance. A coil of intestine was incised, allowing the escape of gas and foul-smelling, liquid feces. Three days later pain, borborygmi and visible peristaltic waves recurred and were almost continuous until the patient's death in September, 1905, six weeks after the operation. Autopsy showed every organ wasted but otherwise healthy. The intestines appeared normal both externally and internally.

Case XIV. (Pototschnig.) A twenty-two year old soldier was admitted to the hospital after four days of illness characterized by abdominal pain, constipation, vomiting and prostration. Upon examination the abdomen was found to be distended and tender. The diagnosis of ileus was made and operation decided upon. Gastric lavage preliminary to the operation yielded large quantities of greenish, liquid material whereupon the meteorism disappeared completely and the abdomen became flat, soft, and only slightly tender. Laparotomy was nevertheless performed but failed to disclose any abnormality. On general principles the appendix was removed. On the second postoperative day the patient developed severe abdominal pain and bilious emesis and died the following day. Autopsy disclosed two segments of spastic contraction, one involving the jejunum about 20 inches below the duodenojejunal flexure and the other affecting the sigmoid. Each contraction could be restored to normal by pulling on the bowel.

Case XV. (Schule.) A woman, thirty-five years of age, complained of vague dyspeptic symptoms for several weeks. Tenderness in the right upper quadrant led to the suspicion of gall-bladder disease. A severe attack of pain and vomiting finally brought her to the hospital. Laparotomy revealed a strongly contracted, pale and completely empty segment of jejunum which could be filled by compression of the stomach. No other abnormalities were observed. Jejunostomy was performed. Following operation the vomiting continued intermittently until stupor appeared. Death ensued eleven weeks after the operation. Autopsy revealed no changes whatsoever in the intestines. In the floor of the fourth ventricle was a pea-sized, inflammatory tumor the exact nature of which is not stated.

Case XVI. (Sohn.) A sixty-seven year old man was admitted to the hospital with a history of operation for pyloric stenosis sixteen years previous. During the past few years, he had suffered from a Stokes-Adams syndrome but sought hospitalization mainly on account of severe abdominal pain, vomiting and obstipation. The patient entered in a state of collapse, vomiting feculent material. The heart was found to be enlarged and the pulse rate extremely slow (14 per min.). The abdomen was markedly distended, tender to touch and gave audible evidence of increased peristalsis. At laparotomy performed under local anesthesia a distended cecum was immediately encountered. Under the assumption of a colonic occlusion cecostomy was done. The cecum collapsed but no feces appeared. Feculent emesis continued following operation and forty-eight hours after admission the patient died. At autopsy no cause for the ileus could be found. The heart was hypertrophic and the coronary vessels sclerotic.

AUTHORS' CASE

A white woman, thirty-six years of age, was admitted to the surgical service of the Cook County Hospital on February 22, 1929 with the complaints of nausea and vomiting, upper abdominal pain and constipation for three days. In the past history it was stated that the patient had suffered previous attacks of similar nature but of much shorter duration, viz., several hours at the most. These previous attacks subsided spontaneously. In addition to the periodic outbreaks the patient experienced epigastric distress occurring two to three hours after meals relieved by baking soda and by food intake. Constipation and moderate impairment of appetite were of long standing. Three days

prior to entrance the patient was seized by persistent nausea and vomiting, followed shortly by epigastric pain and later by tenderness. Both the pain and tenderness gradually spread until the entire abdomen became involved. Distention appeared the day following onset and together with the nausea, vomiting and pain persisted. No stool or flatus was passed during the three days of illness. The remainder of the history was essentially negative except for blindness since birth, dysmenorrhea for years and slight burning on urination for two days.

The physical examination revealed a poorly developed, white female of about thirty-six, apparently acutely ill. The temperature was recorded as 97.8°F., the pulse and respiratory rates 120 and 22 respectively. The right eye was missing. The left cornea was extensively scarred and could perceive light only. Several of the teeth were carious, the tonsils enlarged and the throat injected. The thorax and its contents were normal. The abdomen was prominent, tense and diffusely hyperesthetic especially in the epigastrium and right lower quadrant. Peristalsis was neither visible nor audible. The rectal examination disclosed hard fecal material in the rectum and small external hemorrhoids. The vaginal examination was negative. The essential laboratory observations included a two plus test for albumen, a moderate number of hyaline and granular casts and a white blood count of 17,800.

The diagnosis of intestinal obstruction was made and operation recommended. Preoperative aspiration of the stomach was instituted yielding 4½ liters of a thin, dark-brown fluid and resulting in a disappearance of the distention. On nothing by mouth and the administration of fluids subutaneously the patient appeared to improve generally. However, the gastric distention continued to recur and to require repeated aspirations. A carpo-pedal spasm which developed was combated by large quantities of saline administered intravenously and subcutaneously. The patient was presumed to be doing fairly well when on March 10, 1929, sixteen days after entrance, she suddenly became critically ill and died.

Autopsy performed by Dr. R. H. Jaffé the day following death disclosed external evidence of emaciation and of abdominal distention. Upon incising the peritoneum the stomach was seen to occupy most of the abdominal cavity and to displace the adjacent structures. In addition to crowding the diaphragm upward to the level of the third rib, the greatly distended stomach with its greater curvature at a line 3 cm. below the sacral promontory, forced the small intestine into the true pelvis. The fluid content of the stomach which amounted to 3½ liters was mucoid and pale gray-brown. The wall of the stomach was thickened due mainly to an increase in the mucous coat, the rugae of which were unusually prominent and pink-gray in color. The pylorus was widely patent, its circumference measuring 8 cm. The duodenum, which was lined by a smooth, purple-gray mucosa, was normal in caliber. The jejunum was irregularly narrowed, varying in circumference from 6.5 cm. in its upper to 4 cm. in its lower portion. The ileum was diffusely dilated in its proximal one-third measuring more or less uniformly 8.5 cm. in circumference. The lining of the ileum in the proximal dilated portion was purple-gray, smooth and covered with thick yellowish mucus. The distal point of dilatation ended abruptly and was succeeded by ileum of normal caliber. The colon presented no abnormalities. The following anatomic diagnosis as dictated by Dr. Jaffe includes also the noteworthy changes found outside of the gastrointestinal tract:

Chronic dilatation of the stomach (gastrectasis); irregular constriction of the jejunum; dilatation of the ileum; chronic gastritis and enteritis; atrophy of the thyroid gland; atrophy of the liver, spleen and kidneys; displacement and compression of the extra-gastric contents by the huge stomach; moderate pulmonary emphysema; calcified lymph glands at the hilus of the right lung; absence of the right eye and scarring of the left cornea; follicular cysts in both ovaries and corpora lutea of the right ovary.

COMMENT

Doubt might be expressed regarding the assumption that death in the cases summarized was due to enterospasm per se. In the cases in which operation was performed the anesthetic, surgical shock, etc., might be considered the direct cause of death. However, even here the laparotomy could hardly be considered an important factor in most instances as the symptoms which

preceded death were usually those for which operation was performed. Furthermore, in the two patients described by Pendred and Schule, the fatal outcome occurred several weeks after recovery from the laparotomy with manifestations of persistent spastic obstruction. Irrespective of what view may be held with regard to the patients who were subjected to laparotomy, it must be conceded that in the unoperated cases no other apparent explanation than an enterospasm can be invoked. It is hardly possible that an organic cause could have been overlooked in those cases examined post-mortem, particularly since an explanation for the obstruction was the chief concern of the pathologist. The feature of fatal spastic ileus which, however, is difficult to explain is the persistency of the contraction after death. Rigor mortis fails to offer a solution to the problem since this phenomenon cannot explain the strict localization to the area involved ante-mortem and the extreme degree of constriction often noted. The presence of some chemical compound which continues to act on the muscular coats of the bowel after death may be postulated.

The etiologic and pathogenetic phases of idiopathic neurogenic spastic ileus although of considerable interest are still in the theoretical stage. Comprehensive and illuminating discussions on these phases are offered by Sohn, Riess, Nagel, Wohlgemuth, Florack, Freeman, Steindl and Zimmerman. From the practical standpoint the diagnosis and treatment are of paramount importance. The detection of a spastic ileus although often difficult and at times impossible can be effected in many instances if care is exercised. A neuropathic constitution and concomitant signs of a vagotonia are generally considered helpful. Kausch, Cherchevsky, Heidenhain and others have for instance stressed the significance of bradycardia. A recent, intense emotional upset as in a case reported by Woodyatt might serve as a clue. The intermittent nature of the obstruction as in the case of Pendred and the tendency to recurrence exemplified by Voisin's patient favor the assumption of an enterospasm. Practically all authors lay particular emphasis upon the fact that in spastic ileus the general condition remains good for an unusually long period of time. Furthermore, the patient's condition is far better than in an individual with a mechanical obstruction existing for a similar period of time. Spastic ileus is generally accompanied by a paucity of physical signs. The abdomen instead of being distended is frequently retracted while visible peristalsis is generally absent. Tenderness which is often elicited is probably an evidence of hyperesthesia. Rarely can the spastic loops be felt or seen. The *x*-ray may prove of aid in demonstrating a variability in the character and location of the obstruction especially in repeated examinations. Antispasmodics (including calcium preparations), sedatives and heat may be of value for therapeutic test purposes.

The treatment of spastic ileus is medical providing this form of therapy proves effective. Where the symptoms of obstruction persist in spite of standard medical treatment surgery should not be postponed until the patient is rendered too feeble to withstand operation. At laparotomy a number of considerations arise. In many instances the enterospasm disappears under the influence of the laparotomy alone. If the anesthesia is ineffective in relaxing the intestinal musculature the spasm may still disappear after the abdomen is opened as a result of drying, cooling, palpation, etc. Especially useful are warm saline applications. Where these measures fail resort may be had to injection of novocaine into the celiac plexus (Lehmann) or into the intestinal wall (Brunning). Since the spasm may be relieved at laparotomy and reappear postoperatively and eventually lead to death (see reports of Pendred and Pototschnig) a number of surgeons recommend enterostomy regardless of the effect of the exploration on the enterospasm. The use of a catheter sutured into the intestine

proximal to the obstruction is based on the assumption that paralysis of the oral portion frequently follows the enterospasm. Some authors, especially Klett, have pointed out that since the site of the spasm varies, enterostomy could be of no avail since another spasm may occur proximal to the operative site. However, experience teaches that this theoretical possibility seldom occurs and that in actual practice best results are obtained with enterostomy. So far as we have been able to ascertain no author has resorted to a short-circuiting operation. We have recently employed this procedure with happy results in a young woman who suffered repeated attacks of spastic ileus the last one of which threatened to prove fatal. She has had no recurrences to date which is three years since the time of operation. Where the presence of a spastic obstruction is established by exploration and the symptoms persist for some time after the abdomen has been closed a second operation with the performance of an enterostomy or anastomosis is indicated.

SUMMARY AND CONCLUSIONS

It is at present generally believed that spastic ileus is a benign affection which relieves itself spontaneously. Whenever laparotomy is performed in the presence of an enterospasm an error in diagnosis with respect to the type of obstruction is assumed. That spastic ileus is not invariably innocuous and can prove fatal if no other than medical means are employed is more than a theoretical possibility. In a review of the literature 15 cases of spastic obstruction which led to death were encountered. An additional one which came under our observation is reported. The occasional fatality following spastic ileus emphasizes the need for surgical intervention where medical measures fail to relieve any obstruction of the occlusion type.

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FULL-TERM RETROPERITONEAL ABDOMINAL PREGNANCY*

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THE report of a retroperitoneal extrauterine pregnancy has interest, not because of the rarity of such cases, but because the symptomatology of abdominal gestation, with the difficulties encountered in diagnosis and treatment, is still a controversial subject.

In a series of 236 abdominal pregnancies discussed by Cornell and Lash,[1] 226 collected from the literature with 10 from their own observation, the preoperative diagnosis was correct in only 83 instances, while in 67 cases the diagnosis was not mentioned. The age incidence extended from fifteen to sixty-four years, naturally occurring most frequently between the ages of twenty and forty, among primiparae and secundiparae. The fetal mortality, 59.7 per cent, plus the early infant mortality (death within forty-eight hours) gave a total mortality of 67.3 per cent. The maternal death rate was 14.3 per cent, principally the result of peritonitis and shock.

One hundred and twenty case histories reported in the literature during the period 1919–1933 is the basis of a statistical study by Mundell of Georgetown University.[2] Without consideration of the five "embryonic" deaths, an analysis of the remaining 115 cases is tabulated as follows:

Full term or near-term pregnancies	61
Normal live babies	31
Normal dead babies	13
Deformed live babies	7
Deformed dead babies	1
Macerated babies	9
Maternal deaths	14
Premature pregnancies, 6½–8 months	18
Normal live babies	10
Normal dead babies	3
Deformed live baby	1
Macerated babies	4
Maternal deaths	6
Post-mature pregnancies, 10–22 months	36
Normal babies	16
Macerated babies	14
Mummified babies	3
Development not mentioned	3
Maternal deaths	4
Total number of live babies	49
Normal	41
Deformed	8
(No mention made of neonatal deaths)	

The case to be reported is unique, not because it belongs to the category of extrauterine pregnancies, but because it was a retroperitoneal development of eight and a half months. The fetus was found posterior to the retroperitoneum, the placenta adherent to the retroperitoneal veins. Superiorly the sac reached the level of the lower pole of the left kidney; the inferior portion of the sac was in the pelvic cavity directly above the cervix. The vascular placental attachment, with the consequent adequate blood supply to the fetus, was undoubtedly responsible for this retroperitoneal pregnancy coming to term. Annexation at other loci would have been productive of an early fetal death.

But the dangers of this type of pregnancy are apparent. There is the liability of the extremely thin sac to rupture with the resultant escape of amniotic fluid into the peritoneal cavity. The sac, of course, does not respond to the contractile stimulus of pituitrin. Another untoward result to be feared is possibility of fatal hemorrhage, should the placenta become detached from the venous plexus.

[1] Cornell, E. L., and Lash, A. F. Abdominal pregnancy. *Internat. Abstr. Surg.*, 57: 98–104 (Aug.) 1933.

[2] Mundell, J. J. Full term abdominal pregnancy. Report of a case. *Med. Annals. D. C.*, 2: 86–90 (April) 1933.

* Read before the Puget Sound Surgical Society, Seattle, Wash.

CASE REPORT

Mrs. W. S., aged forty-one years, came for consultation February 5, 1933, on account of the increasing size of her abdomen. Thought to be developing a tumor, she requested an examination. She was in the best of spirits, feeling exceptionally well.

History. She had been married twenty-one years and denied miscarriages and pregnancies. Her family history was negative, also her own history, except for an undiagnosed illness at the age of twenty-three, when a three months' attack of low abdominal pain had been associated with profuse bleeding, without chills or fever. Her physician had suspected an abortion, but no currettage was done. This may have been a spontaneous abortion; she fully recovered in three months.

Her present condition, an enlargement of the abdomen, had developed during the past two months, gradually becoming so noticeable as to prevent her usual clothing. As there had been no catamenia since August 31, 1932, prior to which time her menstrual history had been normal, she suspected the menopause. A few days of nausea immediately following August 31 was attributed to diet indiscretion. She also experienced a fainting spell early in September. During the latter part of October she had flowed for ten days; during the first week of November, she was seized with a sudden acute pain in the lower abdomen, gradually subsiding though not entirely disappearing until about the first of December. Since that time there had been neither sign nor symptom of abnormality or pregnancy, except the enlarged abdomen for which she sought relief.

Examination. The patient was of large stature, 175 pounds in weight, apparently in vigorous health. The head, heart and lungs appeared normal on examination; the thyroid was slightly palpable. Temperature was 98.4°F., pulse 88, respiration 18, and blood pressure 132 systolic, 88 diastolic. The red blood cells numbered 4,100,000, hemoglobin, 87 per cent (Hellige); white blood cells, 7000; Wassermann reaction and urinary findings negative.

Abdominal examination disclosed a palpable mass, completely filling the lower abdomen, and extending three fingers' breadth above the umbilicus. The pelvis mensuration was well above normal. Auscultation revealed fetal heart tones to the lower left of the umbilicus, 128 per minute. On bimanual examination the cervix was soft and a fetal head could be palpated immediately above it. On direct inspection with the speculum, the vaginal and cervical tissues presented the characteristic bluish hue of pregnancy. There was no adnexal tenderness nor palpable masses.

Radiographic study of the abdomen and pelvis was interpreted as a normal six months' fetus lying in the left flank, back to the midline with head at the superior strait.

Course. Urine and blood pressure, at bimonthly examination, were normal throughout the antepartum course. She performed heavy farm work, yet felt exceptionally well and seemed to resent advice to the contrary, making light of the fact of pregnancy.

April 15th, an extremely fetid discharge, dirty brown in color, suddenly commenced, gradually increasing until at the end of three days it had become bright red. The metrorrhagia ceased after ten days' rest in bed, during which period there was complete absence of pain. Several examinations rectally disclosed no unusual findings, the head being high and the cervix not dilated. Vaginal inspection with the speculum revealed nothing alarming. Bleeding was found to be oozing from the cervical canal, and the examining finger could elicit no placental tissue. The fundus was at the costal arch; the fetal heart rate 124. A placenta praevia or partial separation of a marginal placenta was suspected. The patient was closely observed in view of expectant treatment.

May 11th, she was seized with intense pain through the hips and back,—a constant pain, rendering it impossible for her to recline. But there were no labor pains. The abdomen was hard and exquisitely tender. Her pulse was 94, the facies gray and haggard. Rectal examination showed no descensus of the head, nor dilatation of the cervix. Perception of the fetal heart tones was now difficult. She was immediately hospitalized, and radical treatment for delivery was considered justifiable.

Operation, May 11. Low ceserian section through a low rectus incision. On retraction of the intestines, the fetal sac was exposed with the sigmoid colon lying diagonally across the sac (Fig. 1), which was then incised below the colon and the fetus extracted. The fetus (weight, 7 lb., 4 oz.) had evidently been dead several hours. An ovarian cyst about the size

of an orange was accidently opened at the lower end of the incision. Due to hemorrhage, exploration of the cavity was difficult. After packing the sac with gauze, a survey of the pelvis proper revealed the normal uterus compressed to the extreme right, with the cervix curved toward the midline. The wall anterior to the sac was the retroperitoneum, and posteriorly, the iliopsoas and the quadratus lumborum muscles. The lower pole of the left kidney was palpable at its superior level, while the inferior portion was in the pelvis. The left ureter disappeared beneath the placenta, which was adherent to the retroperitoneal veins (Fig. 2).

Despite careful removal of the placenta, profuse hemorrhage resulted, controlled by tightly tamponing with hot saline pads. After excising a large redundant portion of the sac, Penrose drains were inserted in the sac, and the wound closed. Third degree shock, due to the loss of blood and delay in removing the placenta, was promptly overcome by the intravenous administration of glucose and saline solutions.

Recovery was uneventful, the patient discharged by ambulance in ten days. During three weeks' convalescence at home the wound drained constantly. She is in the best of health at present, performing her usual heavy work.

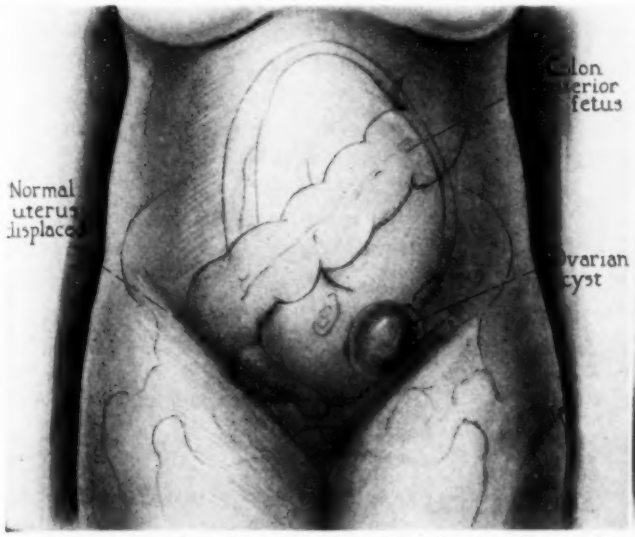

Fig. 1. Condition found on opening of abdomen. Sigmoid colon lay diagonally across sac, while head was presented at superior strait with ovarian cyst to its left.

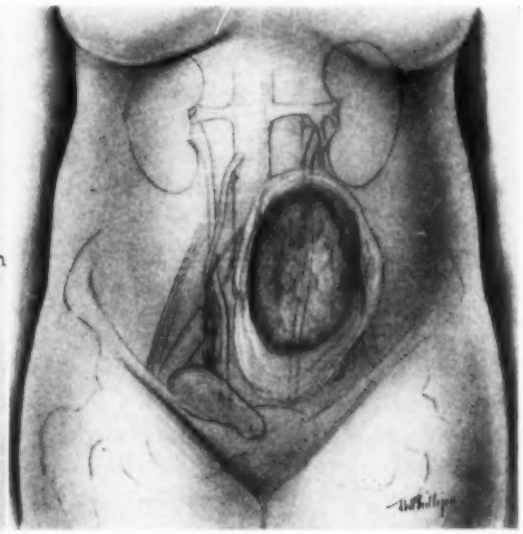

Fig. 2. Placenta is shown directly in front of retroperitoneal venous plexus, under which organ disappearance of left ureter is diagraphically indicated. Normal uterus, compressed tightly to right of lesser pelvis, is also demonstrated in Figure 1.

COMMENT

A normal pregnancy was presented, both at the initial and at all subsequent antenatal examinations. The fetus was palpable, its position readily diagnosed directly above the cervix with the head at the superior strait. The uterus, which was found at the right of the true pelvic cavity, could at no time be palpated, but the roentgenegram showed a normal fetus with the head in the pelvis.

The intense pain in her hips is rather difficult of explanation; it was probably the result of rupture of the fetal sac into the tissues of the pelvic proper. The foul discharge and bleeding, the month prior to operation, was our only indication of a pathologic condition. There was no evidence of the actual situation; nevertheless, procrastination would have meant a peritoneal or vascular death.

DISCUSSION

Dr. William M. O'Shea: Dr. Longley is to be congratulated on the successful completion of a very difficult problem. I may mention that my own observation is limited to only one case,

which went unrecognized until postmortem. The patient was seen by me in consultation about four days after an attempted criminal abortion. It was unfortunate that the question of abortion in association with the history of sudden terrific pain obscured our good judgment, so that a waiting policy was advised—with disastrous results. At postmortem examination it was evident that the abdominal pregnancy had been extruded from the left tube to the sigmoid colon. The colon was seen to be perforated. This may be explanatory of her apparent collapse just prior to the time I was called, and of her subsequent death.

Dr. H. Garner Wright: The case reported is a most interesting contribution, as this condition is rarely encountered among the many complications associated with pregnancy. Ectopic gestation takes several forms, the most common being the tubal pregnancy, which may be the tubal proper, tubal abdominal, or interstitial. Secondarily, there are ovarian pregnancies, the ovum remaining in the Graafian follicle (primary type) or else developing partly in the follicle and partly in the peritoneum. Lastly, we have the abdominal or peritoneal pregnancies, the ventral, free in the abdominal cavity, and also pregnancies attached to the folds of the broad ligament. From the locus of the placenta in question, this case may be said to belong to the latter classification, entering into the broad ligament and developing retroperitoneally. For any of these abnormalities to continue their evolutionary process without accident is indeed unusual, nor does the fetus commonly develop normally. Although the early course is generally that of a normal pregnancy, phenomena symptomatic of rupture, false labor, or retention make their appearance later, evidenced by pain, menstrual irregularity and peritoneal irritation.

Consensus of opinion holds that, unless the placenta can be removed without danger to adjacent viscera or blood vessels, it were best to leave the organ intact. Removal may be made at a later date, although absorption without ill effects is the general rule. In anticipation of difficulty, the membrane can be stitched to the anterior abdominal wall, the incision left open at this point. However, if absorption is not taking place in the next few weeks, the placenta may be gradually removed, through the agency of a Kelly cystoscope and an alligator forceps.

Notwithstanding these admonitions, when feasible the placenta may be removed with the fetus provided the life of the mother is not placed in jeopardy. And in this instance it was practical to do so. The end-results testify to the surgical judgment.

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* Continued from p. 341.

CARCINOMA OF THYROID WITH MULTIPLE METASTASES*

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PITTSBURGH, PA.

THE occurrence of malignant neoplasm of the thyroid is of sufficient rarity to warrant calling attention to this instance. In large clinics where many thyroids are observed, both clinically and pathologically, it has been stated that the incidence of malignancy is from 1 to 3 per cent (Graham[1] and Clute[2]). Some years ago L. B. Wilson said, "Correct early diagnoses of malignant tumors in the thyroid are made probably less frequently than of malignant tumors involving any other organ of the body." While heightened interest has increased the number of these tumors recognized, doubtless many still are missed. There are several apparent reasons for the difficulties in the proper recognition of malignancy, among which can be mentioned: (1) The difficulty of histopathologic diagnosis, due to the variable picture which results from the peculiar manner in which the thyroid develops. (2) The fact that the thyroid is unusually responsive to functional stimuli, resulting normally in a widely varying histological picture. (3) An unsatisfactory terminology often used to hide lack of definiteness.

Graham[1] reviewed a large number of thyroids, and has described a criterion for accurate diagnosis of the more difficult group of malignancies of the thyroid. He demonstrated that the group classified as adenoma, often with modifying terms added, indicating early or suspicious malignancy, can be definitely assigned to the malignant grade where invasion of blood vessels or capsule can be demonstrated histologically. The absence of such invasion warrants placing the lesion as a benign one. Recently a large series of malignancy of the thyroid was reviewed by Smith, Poole, and Olcott,[3] in which an extensive analysis of the clinico-pathology of the disease was given. The classification and terminology presented by them is particularly helpful because of its simplicity and usefulness in prognosis.

CASE REPORT

W. A., male, sixty years of age, was admitted for surgical relief from an enormous tumor of the thyroid of twenty years' standing (Fig. 1 *a*, *b*).

The tumor began as a small rounded and symmetrical enlargement at the base of the neck. In the intervening years it had slowly enlarged until at the time of admission it was the size of a grapefruit. This mass caused him no discomfort until one year before admission, when he began to notice that he easily became fatigued. He then suffered successively from embarrassment of respiration, low backache radiating down both thighs, and pain in the lower cervical region radiating down the right arm. Just before admission his voice became more highly pitched and some hoarseness was noticed.

On admission he was emaciated but said he had only lost 8 lbs. in weight over a period of two years. Physical examination showed no evidence of thyrotoxicosis. His general condition and laboratory findings were normal. No satisfactory basal metabolic rate could be obtained because of dyspnea. His larynx showed evidence of pressure on the right recurrent laryngeal nerve. The mass in the neck was smoothly rounded, firm, and partially fixed to underlying structures. The skin over it was tense and brawny.

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He was operated upon under local anesthesia and a small mass of the tumor resected. Considerable hemorrhage was encountered. The

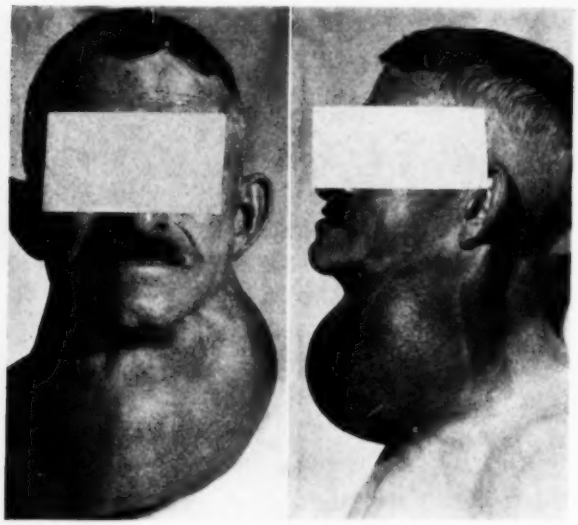

FIG. 1. Anterior and lateral views of tumor on admission.

microscopic diagnosis was adenoma of the thyroid. Recovery was uneventful and the patient was sent home to return later for a second partial thyroidectomy.

Two weeks later, following a "cold," he began to have progressive loss of strength, tingling and edema in both legs, especially of the left leg. The night before admission he suddenly became paralyzed from the waist down and was sent into the hospital by ambulance.

On second admission it was found that the incision in the neck had healed. He was extremely dyspneic. The larynx was located at the extreme right of the neck, high up under the angle of the mandible. The tumor mass had regained its original size and contour. He had extreme difficulty in swallowing and had to be fed through a nasal tube. There was no paralysis of the diaphragm or larynx, but a pseudo-paralysis of the left eyelid, bilateral loss of sensation up to the level of the third thoracic segment, and complete paraplegia, with preservation of the deep reflexes. He had urinary retention and pain over the seventh and eighth cervical roots. The spinal fluid was essentially normal. The *x*-ray examination revealed secondary malignancy in the first and second dorsal vertebral laminae. A diagnosis of compression myelitis was made. The patient rapidly became comatose and died.

At autopsy the tumor in the neck was found to be round and smooth, apparently encapsulated, not extending into the thorax and not attached to underlying structures. On gross section its cut surface was granular, grayish-

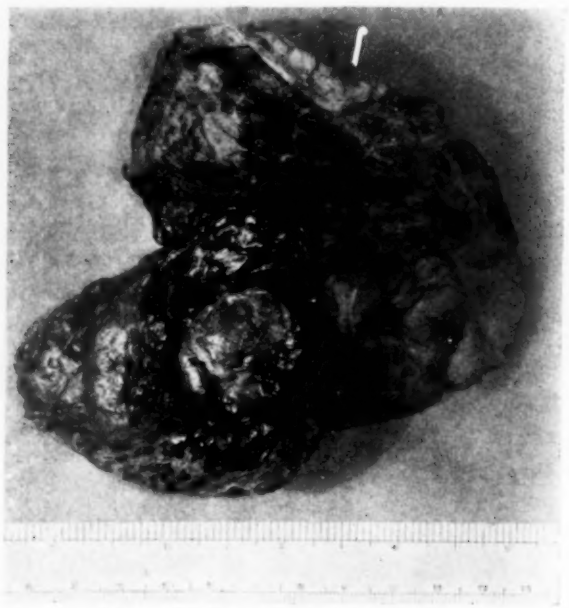

FIG. 2. Gross, metastasis in lung.

white, and soft. There were scattered round nodules in the lungs which in the gross suggested thyroid tissue (Fig. 2). Secondaries were also found in the clavicle, first and second thoracic vertebrae, fifth lumbar vertebra, peribronchial lymph nodes, ribs and pleura. Those in the thoracic vertebrae had destroyed the vertebral spines and arches, so that an annular compression of the cord had occurred. Those in the fifth lumbar vertebra were confined to the ventral surface of the body, bulging as a stony hard mass behind the left iliac vein and artery, so as to partially obstruct both.

Microscopically, the nodules in the lung presented a picture like that of colloid goiter (Fig. 3), while the secondaries in bone were quite cellular and embryonic in character (Fig. 4). Sections of the thyroid tumor obtained at autopsy presented a more or less uniform sheet of cells, in some areas arranged on a basement membrane. They were irregular in size and outline, showed a pale granular cytoplasm with nuclei showing occasional mitotic figures (Fig. 5 *a*, *b*).

DISCUSSION

Clinical symptoms seldom lead to recognition of malignancy of the thyroid except in those rare instances in which a rapidly growing thyroid tumor with rapid downhill

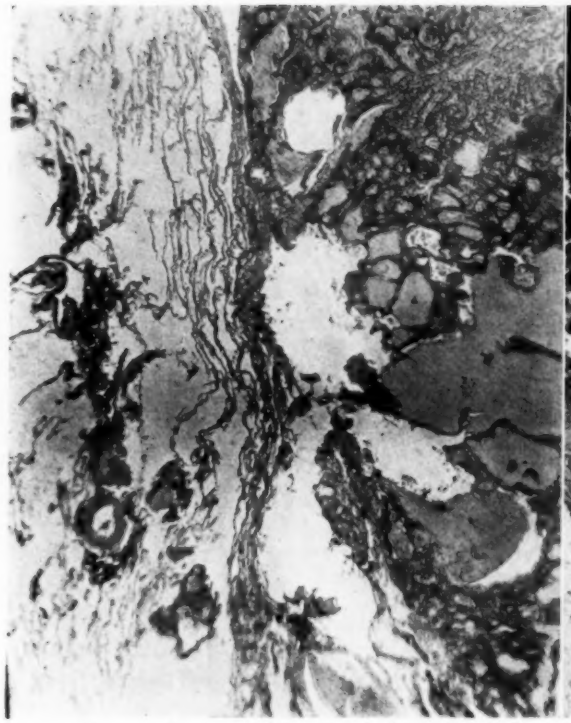

FIG. 3. Low power, metastasis in lung.

FIG. 4. Low power, metastasis in bone.

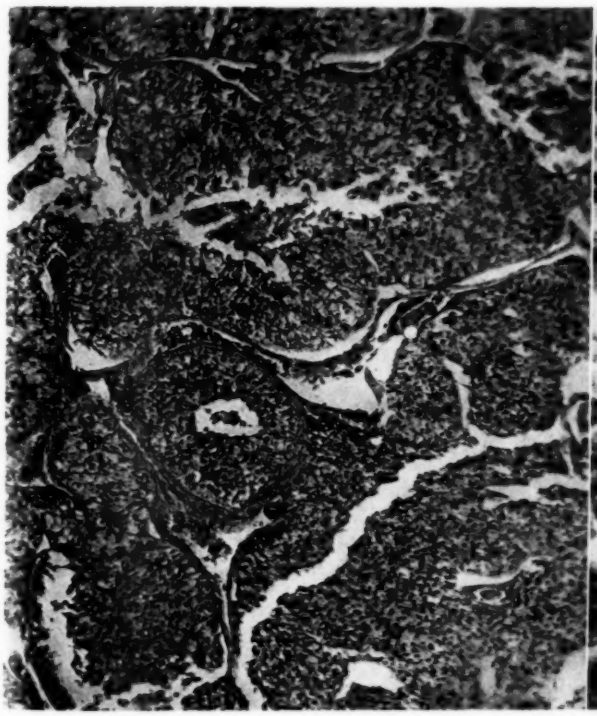

FIG. 5A. Low power, original tumor. Small round-cell type of carcinoma.

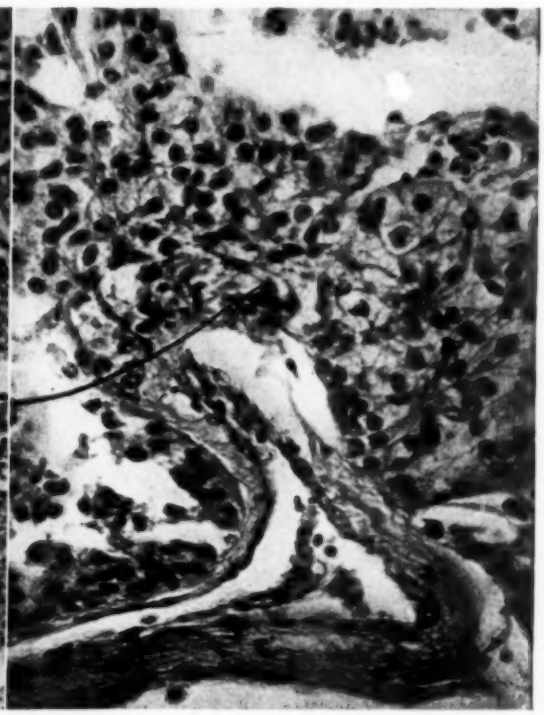

FIG. 5B. High power, original tumor. Small round-cell type of carcinoma.

progression of the patient make the diagnosis of malignancy obvious. In the case presented the patient had had an unsightly but otherwise harmless and symptomless tumor for twenty years. It has been said that hardness, fixation, and rapid growth should make us suspicious of malignancy and that when these are accompanied by hoarseness and interference with breathing and swallowing, the course of the disease is apt to be rapidly fatal. The malignancies of the thyroid studied by Clute[4] were divided by him into three classes: those showing little histological evidence of malignancy, making up about 70 per cent of his total number; those showing adenocarcinoma of papillary or alveolar arrangement, comprising 11 per cent, and small celled carcinoma, making up the remaining 19 per cent, to which this neoplasm belongs, is by far the most fatal, and is made up of those showing easily recognized clinical symptoms. The fact that the patient whose case is here presented went twenty years without symptoms and then within a year died of a rapidly metastasizing malignant disease, again forcefully brings to our attention the fact that the early surgical removal of any suspicious nodule, together with accurate histopathologic diagnosis, remains our hope for cure of cancer in the thyroid or elsewhere.

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* Continued from p. 348.

RETROPERITONEAL CYSTIC TUMOR

CONTAINING ABERRANT ADRENAL TISSUE*

FREDERICK C. HILL, M.D. AND J. W. MCGEE, M.D.

OMAHA, NEB.

THE following case is reported because of the interesting diagnostic problems which it presented, and because of the unusual nature of the tumor.

The patient, a creamery man, fifty-seven years of age, was first seen by one of us (J. W. M.) in March, 1933 when he complained of diarrhea and pain in the lower abdomen. He had been losing some weight but his general examination was negative and an *x*-ray of his colon at that time showed only some dilatation of the colon. On April 30, 1933 one of us was called to see him again and the other (F. C. H.) was called in consultation. His chief complaint at that time was swelling of the abdomen and some pain in the lumbar region which had started one week previously. He stated that he had been losing weight for the past eight months. His weight, normally, was 216 and his present weight was 170 pounds. He had also gradually been losing strength and his appetite had been poor for about the same length of time. Five or six months previously he had been told that his blood pressure was 200 and he had been reducing his diet and ascribed his loss of strength and weight to the small amount of food he had been eating. For about three months he had been troubled with intermittent, at times rather severe, pain in the lower abdomen. The pain frequently came on about one hour after meals, especially if he had eaten anything sweet or greasy. He had no pain at night and had not found anything that would relieve the pain. His abdomen had apparently been gradually getting larger, but he first noticed it one week ago, his attention being called to it by some occasional dull pain in the lumbar region. He was spending almost half the day in bed and the rest of the time sat up in a chair.

His past history was negative except for an attack of hematuria thirty years ago following a blow in the abdomen.

On physical examination it was noted that he was rather pale, and his blood count showed 85 per cent hemoglobin and 4,300,000 erythrocytes. There was no leucocytosis.

The apex of the heart was in the fourth intercostal space, 4¾ inches from the midsternal line. In spite of this, the apex was inside the nipple line because the chest was expanded outward and the diaphragm was elevated on the left side by pressure from below. A large mass filled the left upper quadrant and umbilical regions causing marked distention of the abdomen. The mass was smooth and fluctuating and did not shift when the patient's position was changed. It was thought that a fluid wave could be elicited. The urine was negative. *X*-ray of the colon showed the colon to be displaced to the right by a large mass about 20 cm. in diameter in the left upper quadrant.

The presence of a large abdominal tumor in a man of this age led us to think of a number of conditions. We believed that the tumor was cystic in nature but it was difficult to be certain, especially since some of the solid tumors, such as lipomata, may be very deceptive. Retroperitoneal lipoma was considered as was also retroperitoneal sarcoma. Both of these tumors may grow to enormous size and, since lipomata in this situation usually undergo sarcomatous change, both may cause the patient to become rapidly emaciated.

Tumors of the kidney, the most common of which is hypernephroma, may also reach considerable size, and since they are very soft, they may easily be mistaken for a cyst.

Of the cystic tumors in males, practically all are retroperitoneal in origin, although small mesenteric cysts do occur and we

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have seen one large cyst, about 10 inches in diameter, which developed in a sarcoma of the stomach. Dermoid cysts are tumors

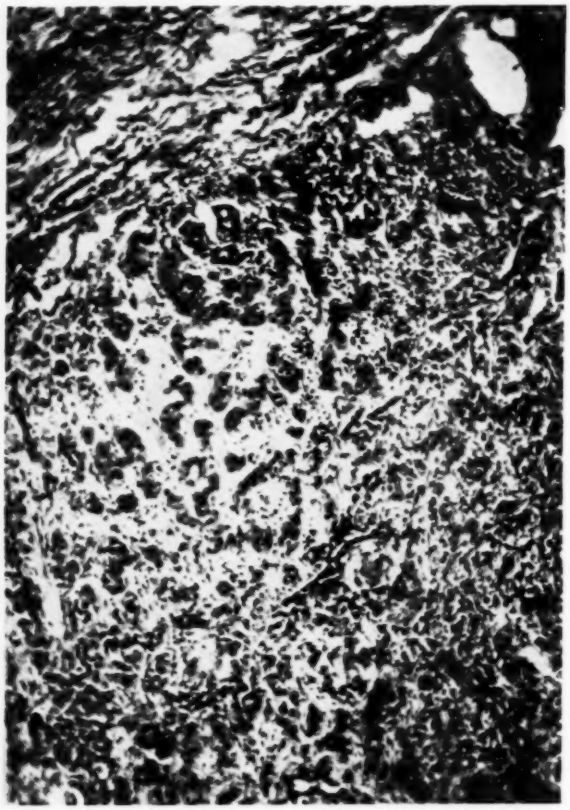

Fig. 1. Section of tumor showing island of adrenal tissue.

which may occasionally develop retroperitoneally, but they practically never reach such size as in the present instance.

Dr. C. F. Dixon, of Rochester, Minnesota, recently told one of us about an unusual case which he had encountered. His patient was a young woman, and at operation she was found to have a large cystic tumor which presented through the gastrohepatic omentum and originated near the pancreas. This was diagnosed microscopically as a hemangioendothelioma, but it was the first case of that type seen at the Mayo Clinic and no similar cases have been reported elsewhere.

Cysts of the pancreas, although an uncommon condition (White found only 3 cases in 6078 autopsies at Guy's Hospital) are probably the most common large cystic tumors in the male. They usually occur between the ages of twenty and fifty, although the congenital type may be seen in children. They usually cause some rather indefinite digestive symptoms, loss of flesh, and gradual enlargement of the abdomen. Undigested muscle fibers may occasionally be demonstrated in the stool in these cases, but this is of little practical value in their diagnosis.

Our opinion up to this point was that this patient probably had a pancreatic cyst, although there were certain aspects of the history which were rather confusing, and we also felt that if possible a tumor of the kidney should be ruled out. It is to be noted that this patient was examined and his colon was *x*-rayed in March and no tumor was found. Only two months later, he presented this enormous mass. He had also lost considerable weight and because of this and the apparently rapid growth of the tumor we feared that it was malignant, and so informed the patient's relatives, in spite of the fact that cysts of the pancreas are usually benign.

Dr. T. D. Boler was called in consultation and made a cystoscopic examination. He found that the right kidney was functioning normally, but that there was an obstruction in the left ureter so that he could not pass a catheter through it and could not get a pyelogram. Uroselectan was given intravenously but gave no shadow probably because of the large mass in front of the kidneys. In spite of the fact that the condition of the left kidney was still in doubt, we believed that the mass was cystic and our preoperative diagnosis was cyst of the pancreas. We believed that the ureteral obstruction could very well be caused by external pressure of the mass.

At the operation performed on May 4, 1933, the abdomen was opened by a left rectus incision about 4 inches long, and a large, smooth, cystic mass presented itself. There seemed to be no nodules in the pelvis or on the peritoneum, so the incision was enlarged to about 12 inches, extending downward from the costal margin. The cyst was retroperitoneal in origin, pushing forward a collapsed descending colon. It was thin walled and had a bluish color except where it was covered by a thin layer of fat. It presented itself through the transverse mesocolon near its origin, and extended with a wide base from a point medial

to the cecum to an area behind the spleen. The spleen was normal in size and was pushed forward and laterally by the mass. In the lower right part of the base of the cyst a very indurated area was felt which seemed to be a thickening of the cyst wall. A piece of the tissue in this region was excised for microscopic examination. It was not considered wise to attempt to get an entirely satisfactory specimen at this point, however, because of the danger of puncturing the cyst or cutting the vessels of the descending colon, which had been pushed over to this region. A lymph gland was found near the upper border of the cyst; it felt rather hard and was excised for study. With a finger in the foramen of Winslow the pancreas could be felt and seemed to be firmer than normal. No masses could be felt in this region, but the examination was difficult because of the location of the incision. The liver and intestines appeared to be normal. The kidneys could not be palpated because of the large mass of the cyst lay directly in front of them.

A purse-string suture of 00 chromic catgut was inserted in a prominent area of the cyst wall, and inside this a stab wound was made and a large catheter inserted and anchored in place. Approximately 4 quarts of brownish liquid with a consistency resembling that of serum were evacuated. After the cyst was partially emptied several very firm, irregular masses could be felt retroperitoneally. One of these was in the right lower part of the cyst where the first specimen was taken, and was about 4 cm. in diameter. Another mass, a little larger, was felt nearer the midline. In the left upper quadrant another large mass could be felt. These masses were considered to be not incompatible in position with outgrowths from the pancreas.

The catheter was brought out through a stab wound in the left side of the abdomen, the cyst wall was sutured to the peritoneum, and the wound was closed in the usual manner.

The specimens removed at operation showed no evidence of malignancy, but since no tissue was removed from the firm retroperitoneal mass, we were still convinced that the tumor was malignant.

For a few days after the operation the fluid which drained from the cyst continued to be brown in color, but it then assumed a milky or chylous character. A specimen of this white fluid was examined and found to have a Ph of 7.6. Under the microscope a few lymphocytes, many bacteria and a few mucus shreds could be seen. The fluid would not digest casein after several days' incubation, either with or without the addition of calcium.

The patient left the hospital on the fourteenth day but his general condition gradually became poorer. He continued to lose weight and had occasional vomiting. The cyst continued to discharge up to the time of his death on August 10, 1933.

Permission was obtained for an examination of the abdomen through the operative wound and this was done in the presence of one of the relatives. The cyst was found to have contracted down but it ascended almost to the diaphragm, pushing the spleen to the left. It extended across the midline presenting below the transverse colon and mainly medial to the descending colon, but the latter was also pushed forward. Posteriorly, the wall of the cyst was thickened by a firm, irregular mass about 2×3 inches in diameter which was intimately attached to the posterior body wall just below and touching the pancreas. The mass completely encircled the abdominal aorta, and could not be removed without severing the artery. The pancreas was removed and appeared to be normal, although it was somewhat firm. The gall bladder was thin-walled and distended. The other abdominal organs and the kidneys and adrenals were normal. The thoracic cavity and the neck were not examined and the prostate was not removed. At the conclusion of the necropsy we knew that this was a malignant tumor arising in the retroperitoneal tissues near the pancreas, but we were still uncertain as to its nature. The tumor, which had been excised en masse, was preserved for microscopic study.

Description of the Tumor (B. Carl Russum, M.D.). The tumor consists of infiltrating tubes and strands of hyperchromatic, hypertrophic polygonal cells which in places assume an alveolar structure. Mingled with these types of cells there are columns of acidophilic polygonal cells of the fetal adrenal cortical type. Here and there one sees a collection of lymphoid cells. In general, the amount of stroma is large. Diagnosis: adenocarcinoma Grade IV of undetermined origin, containing fetal adrenal tissue.

A section of the cyst wall shows chronic inflammation and tumor invasion.

COMMENT

Retroperitoneal adenocarcinoma is usually metastatic in origin, but primary adenocarcinoma may develop from a retroperitoneal organ such as the pancreas, the kidney, or the adrenal gland. In this case the tumor did not arise in the pancreas and the kidneys and adrenals were normal. The tumor did not resemble metastasis from a prostatic carcinoma, nor did its appearance suggest a testicular origin. We have, moreover, been unable to find any reference to a metastatic retroperitoneal growth producing an enormous cyst such as was present here. The presence of fetal adrenal tissue suggests two possibilities: (1) that the tumor may have originated from an adrenal rest; (2) that the adrenal rests were surrounded by the tumor in its growth. The tumor does not resemble the common types of growths originating in adrenal tissue but, according to Ewing, when a carcinoma develops from adrenal rest the tumor may lose all resemblance to ordinary types and may appear to be an adenocarcinoma. The origin of such a tumor may, according to the same writer, be difficult or impossible to prove.

We believe that this case is of interest not because we have definitely established that the tumor arose from an adrenal rest, but because the accumulation of data from this and similar cases may later suggest a means by which such a diagnosis may be made with assurance.

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* Continued from p. 367.

RIEDEL'S STRUMA*

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THIS type of thyroid gland disease was first described by Riedel[1] in 1896. Because of its woody or iron hard consistency, its fibrous degeneration and chronic inflammatory nature, it has been designated by various names by different authors, such as Riedel's disease, Riedel's thyroiditis, woody thyroiditis, iron hard thyroid, ligneous thyroiditis, chronic productive thyroiditis, fibrous degeneration, primary chronic inflammation, canceriform inflammation, infiltrating fibroma and benign granuloma, all fairly descriptive of the condition of the thyroid gland as described by Riedel.

In 1912 Hashimoto[8] described 4 similar cases which he thought were not to be identified with Riedel's iron hard struma and termed the condition struma lymphomatosa. Ewing,[29] as well as Shaw and Smith[14] and many of the recent writers believe that Hashimoto and Riedel have described the early and late stages of the same pathological condition, while Graham[22] in a recent article groups the cases reported into separate classes, as Riedel's struma and Hashimoto's struma, considering that the former more nearly approaches true inflammation than the latter. Other writers, Heyd,[19] Maloney[21] and Ewing[29] reported sequences of as many as 3 cases of Riedel's struma, ranging from early to late stages and noting the change in pathology, while Graham and McCullough[23] in their recent article, have not only pointed out what they consider a difference in pathology, but difference in age groups, symptoms and also the behavior of the lesion as regards deformity of lobes, diffuseness and adherence to overlying structures.

Reviewing the cases reported and the difference in nomenclature one is impressed with the interlocking of symptoms, age, gross and microscopical pathology. Almost every clinician and pathologist has been impressed by the woody or iron hard consistency of the gland, the fibrous tissue present on section, and symptoms of constriction out of proportion to the size of the lesion. The symptoms produced range from simple hoarseness, tenderness over the gland, dry cough and general nervousness with lack of symptoms of hyperthyroidism and hypothyroidism to such severe ones as dyspnea, dysphonia and dysphagia.

This condition is more frequent in women than men, about three to one, and occurs principally between the ages of thirty and fifty years. The youngest case reported was in a patient twenty-three years of age, although Riedel mentions a probable case in a patient of four years, and the two oldest patients seventy-two and seventy-five, reported by Graham and McCullough[23] as struma lymphomatosa. It is their contention that this disease occurs in later years than does Riedel's struma.

ONSET

This varies from a month or two to several months in the majority of cases, but Spannaus[7] reported a patient with swelling of the gland symptomless for seven years, who then developed dyspnea and dysphonia.

SYMPTOMS

The symptoms are the result of actual pressure on or constriction of the trachea, esophagus, recurrent laryngeal nerve, and

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adjacent tissues of the neck. They are not in proportion to the size of the tumor but to the hardness of the mass and more particularly to the perithyroiditis and extracapsular fibrous invasion of surrounding tissues. While some patients complain only of presence of the tumor mass, with no other symptoms, the most frequent and constant one is dyspnea which may be so severe as to require tracheotomy, as in several of the earlier cases reported. This has not been required so frequently in later ones, possibly due to earlier observation and relief. Sixteen of Shaw and Smith's[14] 23 patients reported dyspnea.

FIG. 1. Path. No. 18506. Thyroid showing fibrosis with lymphoid infiltration and scattered giant cells.

The gland may be tender on palpation and even painful in some cases, and pain may radiate slightly to surrounding parts. There may be hoarseness, dry cough, soreness of the throat, pain on swallowing, sense of fullness of the throat, and in those cases with marked constriction, there may be dysphonia and rarely aphonia and dysphagia. Some patients show a general nervousness and weakness with loss of appetite, and slight tachycardia or palpitation as well as slight tremor, but these symptoms as well as high blood pressure are not more constant than with this age group. The basal metabolism usually approaches normal. It may reach plus 35 per cent and in one of Barthe's[24] cases was plus 46 per cent. Only the later cases reported have recorded it and we have insufficient data, but the basal metabolism is usually definitely lowered after operation. As previously mentioned, the patient may simply call attention to the swelling of the neck with absence of the toxic symptoms of hyperthyroidism with the stony hard consistency of the gland the outstanding feature. Smith and Clute[16] report no evidence of myxedema in their cases, a condition concurred in by other reports, and they call attention to the fact that the loss of weight, usually reported moderate, may at times be quite marked. This is usually regained after relief from pressure of the tumor. There is usually no rise in temperature, but there may be a slight increase in white blood cell count.

A Wassermann test has been taken in a few of the later cases reported and is usually negative. *X*-rays in advanced cases show a marked tracheal compression as the cause of dyspnea and Maloney[21] thinks it practically diagnostic. Some of the cases reported, probably in earlier stages, do not show this.

As a rule the gland enlargement does not extend below the clavicle. The tumor mass is usually stony hard, does not individually move freely but usually en masse with overlying muscles. More frequently it is bilateral, but may be unilateral, usually smooth and symmetrical, but may give a nodular appearance resembling adenomata, due to the difference in size of lobes and isthmus and the distribution of fibrosis. Next to its stony hardness, the adherence to overlying muscles and adjacent structures, such as the

trachea, lack of mobility and absence of lymph-node involvement are its most characteristic features. This immobility leads to the erroneous diagnosis of malignancy. There is very little motion during the act of deglutition; it possesses no elasticity such as hyperplastic or colloid gland, and it seldom involves the skin, only one such case having been reported.

It is difficult to make out its outline. It is usually characterized by marked extracapsular extension with involvement of the trachea, large and small blood vessels, carotid sheath, and adjacent muscles, making pressure on the trachea and recurrent laryngeal nerve.

Graham and McCullough[23] in attempting to classify this condition into the two classes, Hashimoto's struma and Riedel's struma, use as a diagnostic point, the fact that in the former the gland is closely attached to the trachea without adherence to overlying structures, but most writers merely consider that the extracapsular invasion in these cases has not advanced as far as in the others where the prethyroid muscles and carotid sheath are involved.

Technically, this group of cases presents great operative difficulty. Enucleation is almost impossible due to the extracapsular invasion, the surgeon has to resort to knife dissection entirely, and it is almost impossible to find a plane of cleavage. In advanced cases it is difficult to recognize the structures and in many of the early cases reported, operation was abandoned, or associated with severe operative complications, such as resection of the carotid artery, jugular vein, vagus and recurrent laryngeal nerves, and injury to the esophagus and thoracic duct, with numerous tracheotomies. However, cases reported in the last few years have as a rule not required these tracheotomies, and have shown fewer complications, which with present-day surgical knowledge should markedly lower the death rate.

In view of the fact that this is a progressive lesion, bringing on death by asphyxiation, the treatment of choice is surgical. Some advanced cases will continue to require preoperative tracheotomies, but the immediate relief recorded by various surgeons, by even a partial bilateral or unilateral resection of the gland, would tend to relegate tracheotomy to the past.

The operation of choice is individual; relief of pressure being the object. Heyd[19] thinks complete thyroidectomy should be the ultimate aim of the surgeon, bearing in mind that he must later deal with myxedema which necessitates continuous thyroid feeding. Heyd had a recurrence following resection of one lobe, as did Bruce[25] after three-quarters of both lobes had been removed. The disease may be entirely confined to one lobe, but there is a tendency to spread throughout the entire gland. One case reported by Balfour,[10] which he deemed malignant and inoperable as well, experienced a spontaneous cure in seven years. Silatschek, according to Ewing,[29] observed a spontaneous recovery in a moderately advanced case. Graham and McCullough[23] observing their cases (Hashimoto type) a long time before operation, find that they progress rather than retrogress for a period of at least one year, and that recovery is rather slow following resection of one or both lobes, usually taking about one year, and requiring thyroid administration postoperatively. Other operators are impressed with the quick recovery of their cases, but most agree that at least where both lobes are resected they must feed them thyroid and carefully watch them for at least a year or more.

If a subtotal, partial, or complete thyroidectomy cannot be performed, at least a wedge-shaped piece should be removed from the isthmus, freeing the trachea. In addition to surgery Maloney[21] has used radium successfully and seems to think it is specific. Ewing[29] believes that the most successful treatment is partial thyroidectomy followed by radiation when the entire gland is involved. Several cases reported in the literature treated by roentgen rays alone were followed by

recurrence (Smith and Clute[16]). Most of the cases have been operated upon, and the consensus of opinion is that symptoms are relieved, some immediately, upon removal of even a very small amount of tissue. Occasional aphonia and voice weakness noted in one of Smith and Clute's[16] cases was relieved almost immediately following relief of pressure.

ETIOLOGY

The etiology is unknown. Some of the earlier writers considered tuberculosis and syphilis but this has been discarded by the later writers. Most concur in the opinion that it is a chronic inflammation, and one is impressed by the number of cases showing focal points of infection. Graham and McCullough[23] reported a case following influenza, as does the case being reported, and at least 2 other cases have occurred shortly after attacks of it. Bohan[12] feels that it is a simple infectious condition as his patient improved following extraction of teeth because of abscess and caries.

Berard and Dunet after careful study say it has never been proved to have an association with cancer (Stout[30]). However, the greater number of cases operated upon had a preliminary diagnosis of cancer due to the fibrous attachments and firmness.

Shaw and Smith[14] observed plasma cells in a larger number than are found in lymphoid tissues and felt that this excess speaks for an inflammatory process as does the extension beyond the capsule, the spontaneous recession of the tumor and retrogression after complete or partial thyroidectomy.

Meeker[15] found remnants of the posterior branchial body present in an adult case (the only one reported) and suggests that these may persist in certain persons and infection may reach the thyroid through them, leading to atrophy and extreme fibrous replacement.

Maloney[21] says cases never go through the stage of acute infection, bacteria are not found in the gland, and culture and animal inoculations are negative.

The general consensus of opinion seems to be that it is of unknown etiology, but probably due to infections, such as infected teeth, tonsils and influenza.

PATHOLOGY

Because of the iron hard consistency and adherence to overlying muscles and extracapsular invasion of adjacent tissues most of the earlier and many of the later cases reported have had a preoperative diagnosis of cancer, though the regional lymph nodes and the skin (with the exception of one case reported) were not involved. If the operator has not made the mistake (diagnosis of cancer) previously, he is likely to come to this conclusion during his operation. The gland is hard, cuts like cartilage, or uterine fibroid, may or may not be smooth in consistency, according to the degree of diffuseness and fibrous content, and is greyish white in color.

Hashimoto[8] found numerous lymphoid follicles with active germ centers and some active fibroblastic proliferations in surrounding tissue which some observers of cases consider the early stage of Riedel's disease. The fibroblasts increase as the disease progresses; the acini degenerate and loose their colloid and contain cellular exudate; then, atrophy and foci of round cells appear; lymphoid follicles undergo atrophy and are eventually replaced by advancing fibrosis. Subsequently, the capsule undergoes hyaline fibrosis, and its arteries become sclerosed. Fibrosis continues to progress and reaches beyond the capsule, and many areas of round cell infiltration are found extracapsularly. Giant cells are scattered through the tissues or in the acini. In the advanced cases large areas of thyroid gland are replaced by hyalinized fibrous tissue and only remains of acini and lymphoid follicles can be found. Solid nodules of compensatory glandular degeneration develop in which mitosis is seen. This leads to the erroneous diagnosis of malignancy. Graham and McCullough[23] reported no evidence of mitosis in their cases, and most of the cases reported as

Riedel's struma showed none. Ewing[29] says:

Riedel and others made no mention of extensive infiltration of the gland with lymphocytes or lymph follicles, but Hashimoto described 3 clinically similar cases in which the acini of the gland were largely replaced by very numerous follicles with prominent germ centers. In places these follicles became diffuse. He concluded that he was dealing with a new disease not to be identified with Riedel's struma. I have studied 4 cases which illustrate both the above conditions and in two of them very extensive sclerosis had overtaken and largely replaced the lymphoid tissue. It appears then that Hashimoto and Riedel have described the early and late stages of the same pathological process.

Maloney[21] says:

The cases described by Hashimoto as struma lymphomatosa were probably early cases of Riedel's disease with round cell infiltration and lymph follicle formation. Our 3 cases vary from lymph follicle formation and beginning replacement fibrosis to that of complete loss of thyroid structure and invasion of the carotid sheath and the muscles of the neck.

Heyd[19] says:

The condition is a granulomatus strumitis which has been observed in our laboratory in three stages, the early form representing only a moderate lymphoid increase with compressed epithelial elements, the intermediary form characterized by marked increase in lymphatic tissue with destruction of ephithelial elements and the late stage characterized by an almost complete fibrosis of the gland.

CASE REPORT

C. S., No. 33-1927, a woman, forty-four years of age, was admitted September 14, 1933 to the service of Dr. Robert H. Kennedy. She was married, had given birth to six children, five of whom were living and well; she had had the usual diseases of childhood. There was no history of cancer, tuberculosis or syphilis. Wassermann reaction was negative. She weighed 112 lbs. one year before entering the hospital. Six months previous to admission she was treated by her family physician for high blood pressure, palpitation of the heart and nervousness, attacks of tremor described as trembling of the body, slight headaches and constipation. About one month before admission while confined to bed with influenza she noticed a swollen gland on the right side of the neck, had pain on swallowing, which also affected her right ear, tenderness over the left aspect of the neck and extending to the right side. The tenderness subsided and she was told she had a tumor of the neck and was sent to the hospital by Dr. Peter G. Fagone, Merrick, N. Y.

On admission she complained of dyspnea only on exertion, tremors of body when fatigued, palpitation of the heart, poor appetite, moderate loss of weight, slight headaches, constipation and the presence of swelling of the right side of the neck. She slept poorly.

Physical Examination. Heart, lungs, teeth and tonsils were negative. There was no evidence of focal infection; periods were regular. There was slight pain on swallowing, breathing normal. There was a marked fine tremor of fingers. The eyes protruded slightly which is a family characteristic, her mother having the same type of eyes without known thyroid trouble. Systolic blood pressure 150, diastolic 90; pulse 100; basal metabolism plus 10.3. There was a visible and palpable fullness about 2 inches in diameter on the right side of the neck adjacent to the trachea. It was stony hard and gave the appearance of a nodule in the upper pole of a slightly enlarged thyroid. The entire mass was very hard and extended into the isthmus and left lobe which were small and palpable with difficulty. This tumor mass was slightly movable with adjacent tissues. No extension was visible beyond the normal limitations and there was no tenderness on palpation. The cervical lymph nodes were not palpable. Breathing, swallowing and speech were normal, urine negative.

X-ray. The trachea was not narrowed or displaced; the film showed a possible calcification within the thyroid gland.

Provisional Diagnosis. Calcified adenoma of thyroid? Carcinoma of thyroid? Riedel's struma?

Operation. An incision was made in the lower natural fold of skin of the neck, from a point 2½ inches on the right side to ½ inch beyond the median line, through the skin and platysma muscle. The pre-glandular muscles were divided vertically and transversely on the

right side, the superior thyroid artery ligated, and an attempt was made to enucleate the gland by blunt dissection, which was found to be impossible because of the adherence of the capsule to adjacent tissues. The right lobe and isthmus were removed, leaving the upper pole and capsule. The dissection was difficult but there was a comparatively small amount of bleeding. The tumor mass was not large, but very hard and gave the appearance of malignancy. The left lobe also was very hard, but not larger than the distal and second phalanx of the little finger and was not removed. After approximating the preglandular muscles with plain catgut, the skin incision was closed with six metal clips. The clips were removed in four days, the patient out of bed in six days. Rectal anesthesia (avertin) was used.

Note. The weight, which was 103 lbs. before operation, was 113 lbs. six weeks after operation. Appetite was good, no tremor, she felt well. The pulse, which was 100 before operation, had dropped to 68. The basal metabolism, which was plus 10.3 before operation, was minus 2.5 ten days after operation. There was marked dysphonia following operation and the report of laryngoscopic examination showed: left vocal cord movable, right cord practically immovable. There was fullness of left ary-epiglottic fold; irregularly thickened epiglottis, probably a right recurrent laryngeal nerve paralysis. This dysphonia gradually improved and was completely cleared up four months following operation at which time the basal metabolism was plus 1.35, pulse 72, the patient feeling well and having no nervous symptoms.

The left lobe of the thyroid, which had not been removed, had not increased in size and was palpable with difficulty.

Patbological Report (Dr. D. S. D. Jessup). Specimen consists of the right lobe of the thyroid which is 5 cm. in length × 4 × 2 cm. Outline is rounded and smooth in part with rough areas of adhesions. At the lower pole is a projection 2 cm. in length apparently from the isthmus. The gland is very firm, hard on section and of a uniform fibrous consistency. In the isthmus there is more gelatinous tissue.

Microscopical Examination. Sections show a dense fibrous stroma in which there are many lymphoid cells and a few polynuclear neutrophiles and plasma cells. The capsule is dense fibrous tissue with marked lymphoid infiltration in some areas but with the absence of clinical symptoms of pressure, the process does not appear to have extended far beyond the gland. Scattered through this stroma are groups of acini of varying size. Some of these contain colloid and others show cellular exudate in some cases largely polynuclear. Large giant cells lie scattered through the tissue or in the acini. Some of these giant cells are of the foreign body type, and some are associated with cholesterin deposits in areas of old hemorrhage. There are areas of endothelioid cells but no necrosis and no typical tubercles. Some small blood vessels are thickened. In the isthmus there are similar changes with many giant cells in the acini which contain cellular exudate. The appearance is that of a chronic inflammatory process. While some of the giant cells have the appearance of Langhan's cells there are not the changes sufficient to justify a diagnosis of tuberculosis. Histologically this case would correspond to cases of Riedel's struma reported in the literature, the changes being inflammatory rather than those seen in other types of thyroid disease and new growth of the gland. The fibrosis here has only obliterated part of the acini and the lymphoid infiltration is still marked. This would mark it as an early type of the disease.

Shaw and Smith[14] in 1925 reported 23 cases collected from the literature and added 6. Smith and Clute[16] in 1926 collected 35 cases including their 5 cases, collected from fifteen authors. White[28] in 1932 collected 43 cases including his case; he accepted all of Shaw and Smith's cases and added others from the literature. He did not include the 5 cases reported by Smith and Clute[16] (1926), one by Meeker[15] (1925), one by Matthews[17] (1927), 3 by Maloney[21] (1929), 2 by Oehler[27] (1932). 2 by Diez[26] (1932), which with the case reported would bring the total to approximately 58.

Graham[22] in 1931 in attempting to separate the type of struma described by Riedel in 1896 and that by Hashimoto in 1912 separates 104 cases, reported by eighty-two publications, into ten groups, Riedel's struma 41 cases, Hashimoto's

struma 24 cases, the rest varying from adenomata with fibrous changes to incomplete data. Groups of cases from various clinics have been mentioned but not reported.

No doubt there are many cases that are never reported, but it is of sufficient rarity and of sufficient interest to report the occasional case which one sees so that the ultimate classification may be aided.

SUMMARY

1. The diagnostic features are the stony hard tumor, the immobility, the dyspnea from tracheal compression as shown by *x*-ray in the advanced cases out of proportion to the size of the tumor, the lack of toxic symptoms and of cervical node involvement.

2. The treatment of choice is surgical, complete thyroidectomy, especially when both lobes are involved, and the case is operable. If not, at least a wedge-shaped piece should be removed from the isthmus to relieve the pressure over the trachea.

The results of *x*-ray treatment have not been noteworthy and the data relative to such treatment are meager.

3. Rectal anesthesia is preferable in these cases, avertin is the choice when fibrous extension has not passed the capsule and the prethyroid muscles and adjacent tissues are not involved, and the trachea not constricted. In the advanced cases with marked constriction of the trachea and involvement of adjacent tissues, oil-ether colonic anesthesia as developed by Gwathmey in the Stuyvesant Square Hospital, gives a prolonged anesthesia with a minimum of danger, and the surgeon can do a careful operation without worrying about the length of time he is taking. No doubt the mortality from operations on the earlier cases reported would have been lessened with this type of anesthesia.

4. The pathology is that of a replacement fibrosis, of an earlier lymphoid cell invasion.

5. While the mortality was rather high in the first cases reported and many cases were abandoned as inoperable, or a tracheotomy only was performed, it is noticeable in the later cases that the mortality has diminished to a practically negligible figure.

6. Most of the writers who have either written articles or reported cases, with the exception of Hashimoto in 1912 and Graham and McCullough in 1931, have not chosen to separate the two types of strumas, Riedel's and Hashimoto's, but have considered them to be different stages of development of the same disease.

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[For Remainder of References see p. 360.]

UNILATERAL FUSED KIDNEY

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CONGENITAL anomalies of the genitourinary tract have become of great interest since improved methods of examining them have made their diagnosis possible in the living patient. Unilateral fused kidney appears to be the rarest of these anomalies. Lowsley, writing in Dean Lewis' Surgery in 1933, stated: "It has been recently claimed that only 7 cases are on record where the condition has been diagnosed in a living patient." The first authentic case, according to Stein, was found at post mortem by Hunter in 1785. In 1911 Colmers and Bissel individually reported the diagnosis of 2 cases by the use of ureteral catheters and pyelography. Prior to ureteral catheterization it is not likely that the diagnosis of this anomaly was ever made except at ope ation or autopsy. With the advent of this diagnostic procedure and the increase in knowledge of renal pathology, urologists have become more interested in the search for the various congenital renal defects, since in these conditions the kidneys are peculiarly liable to disease.

According to Pierson, renal fusion anomalies are popularly divided into three groups:

1. One kidney on either side of the spinal column with an isthmus joining the upper or lower poles across the midline, which may consist of renal tissue or of fibrous connective tissue, according to the degree of fusion. This arrangement constitutes the well known horseshoe kidney.

2. Both kidneys fused in an irregular mass, lying near the sacral promontory, with short ureters running direct to the bladder. Such a formation is called lump or clump kidney and is of rarer occurrence than the horseshoe type.

3. Both kidneys fused in one mass, lying on one side of the spinal column, with the ureter from the ectopic kidney crossing the midline to approach the bladder, usually in a normal position. The term unilateral fused kidney denotes such a condition and should not be confused with a congenital solitary kidney. . . . A unilateral failure of development has resulted in the formation of only one kidney and ureter, while in unilateral fused kidney both sides develop and fuse in one mass.

Apparently this anomalous condition is found more often on the right side than the left. The reason for this is not understood. Pierson states that the microscopic structure of the fused mass shows normal renal parenchyma, disturbed only to an extent governed by the degree of fusion.

The exact errors in the embryological development causing renal anomalies can only be conjectured. The metanephros representing the cortex, at about five weeks begins to envelop a small diverticulum in the lower end of the Wolffian duct which is the first indication of the excretory system of the kidney. This diverticulum, after growing, branches out forming the pelvis, calyces, and finally collecting tubules. The pelves at this early stage lie anterior to the cortex. These primary renal masses at this time located in the pelvis, begin to rotate and ascend into the abdomen. Rotation is usually complete at two months. Somewhere in this development an error is committed resulting in a permanent anomaly. It is believed fusion of the early renal masses takes place before migration and usually before rotation has been completed. This fused mass, as suggested by Pierson, in migrating to either side of the spinal column finally results in unilateral fused kidney. Braasch states that in fused kidneys evidence of abnormal rotation

always is found at least in one pelvis and usually both, and that abnormal rotation should suggest some fusion anomaly.

Case 1. Mr. S. white, male, aged twenty-five, was admitted to the Station Hospital, Fort Sill, February 9, 1933; complaining of

Fig. 1.

Fig. 2.

Figs. 1 and 2. Case 1.

Were it not for the frequent complications in unilateral fused kidney such as calculus, pyelitis or pyonephrosis, there would probably be no symptoms leading the urologist to the diagnosis of the anomaly. However Kretschmer accounts for the most frequent symptom of pain by an additional factor—the presence of a large renal mass.

Clinical diagnosis can be made only by pyelography, either retrograde or intravenous. Pneumo-peritoneum has recently been suggested as an aid, but its value seems doubtful. Accurate diagnosis is of profound importance when one realizes that Sexton referred to four cases in which nephrectomy had been performed on the entire unilateral fused mass.

Treatment is governed by the existing complications since no attempt should be made to replace the ectopic kidney.

pain across his entire abdomen, more severe in the right lumbar region and radiating to his back. Onset was insidious.

His previous history was irrelevant except for an appendectomy, performed ten years prior to admission, at which time he was told his right kidney was twice as large as his left. The patient had had a recent attack of gonorrhea, in fact he was a gonorrhea outpatient at the time of his admission. Palpation of the patient's abdomen revealed rigidity and extreme tenderness over a large mass in the right upper quadrant. At the time this was believed to be an enlarged right kidney.

Cystoscopy with ureteral catheterization and pyelography February 12, 1933 resulted in finding both pyelograms to the right of the spinal column. The urine which dripped slowly and intermittently from the right catheter was slightly blood tinged but clear while that from the left catheter dripped rapidly, was cloudy and loaded with pus. This was a surprise as the mass was in the right kidney area. One hun-

dred cubic centimeters were aspirated from this left catheter, but it was too thick with pus to drain fully. On the phenolsulphonphthalein

Fig. 3. Case II.

function test the dye appeared from the right catheter in four minutes after intravenous injection while it failed to appear from the left even after fifteen minutes. *X*-rays showed both catheters going up to the right kidney area. The right pyelogram was noted to be about normal in size and position while the left was apparently a large hydronephrotic sac located just below the right. (Fig. 1.)

The original intention at cystoscopy was to leave the right catheter in situ to drain what we thought was a right infected hydronephrosis. Unfortunately both catheters were removed by an assistant after the urogram. The following day the patient's condition was worse and we tried to insert a catheter up this left ureter again for drainage but were unable to do so. By the next day his conditon was so serious that drainage was imperative and a nephrostomy, done February 14, on the lower or ectopic kidney liberated about 750 c.c. of thick yellow pus. A no. 22 F. Pezzer catheter was inserted and brought out through the lumbar incision for drainage.

The patient improved after nephrostomy but had periods of temperature elevations as high as 102°F. Daily drainage from the tube varied from 1000 to about 2000 c.c. P.S.P. determinations March 20, showed 2½ per cent excretion at the end of the second hour in the urine drained from the nephrostomy tube. Daily irrigations with argyrol or boric acid were continued. On March 21, another *x*-ray was made after 15 per cent sodium iodide was injected through the drainage tube. (Fig. 2.)

On April 5, nephrectomy of the lower portion of the fused kidney was performed after taking the precaution of catheterizing the right ureter. Considerable difficulty was encountered in properly exposing and identifying all structures because of the dense adhesions and scar tissue, resulting from the previous infection and drainage, and because of the small space between the twelfth rib and the ilium in this individual. This difficulty was increased by the enormous size of the double kidney and the low position of the segment to be removed.

The patient was short coupled and the pleura seemed to extend below the twelfth rib. In spite of precautions the pleura was accidentally opened. This, however, was immediately closed and the operation carried to completion. The upper or right kidney appeared normal, but was attached by fibrous bands at its lower pole to the ectopic kidney which was only a large pyonephrotic sac. The ureter from the upper kidney passed posterior across the middle of the lower kidney, through a mass of adhesions and was constantly in the way at operation and probably would have been cut accidentally had we not left a catheter in it for identification prior to operation.

Following the operation the remaining kidney functioned normally. As much as 2000 c.c. of urine was obtained in twenty-four hours; however, his condition gradually became worse and he died on the eleventh postoperative day.

Autopsy showed the remaining kidney in excellent condition, death being due to collapse of the right lung with pneumonia and beginning empyema of the right chest.

Case II. Mr. C., white, male, aged twenty-five, was admitted to the Station Hospital, Fort Sill, January 11, 1934, with the diagnosis of appendicitis. His chief complaint was pain of twelve days' duration in the lower right

quadrant of his abdomen, but there was also slight nausea and constipation.

Examination was essentially negative except for moderate tenderness and rigidity over a definitely palpable mass located under McBurney's point.

Laboratory findings on admission were as follows: White blood count 11,400; P.M.N. 71 per cent; urinalysis, albumin negative; two to three pus cells per high-power field.

After observing the patient until January 17, 1934, it was decided a laparotomy should be done. The mass which was previously palpated was found to be the lower segment of a unilateral fused kidney, one kidney located normally and the other just inferior to it, joined apparently by a firm band. These kidneys were left unmolested.

Incidentally the appendix was quite inflamed and it was believed that a recent attack of acute appendicitis had first focused his attention on this area.

The patient recovered rapidly but was retained in the hospital for a more complete study of his kidneys. On March 1, 1934, cystoscopy and pyelography were successfully carried out, after a previous unsuccessful attempt at catheterizing the right ureter. The bladder mucosa revealed no pathology. Both ureteral orifices appeared normal in size, shape and position. Urine from each kidney was sterile and no pus cells were found except about one to three per high-power field in the specimen from the left catheter. On phenolsulphonphthalein determination the dye appeared from each catheter in four minutes after intravenous administration.

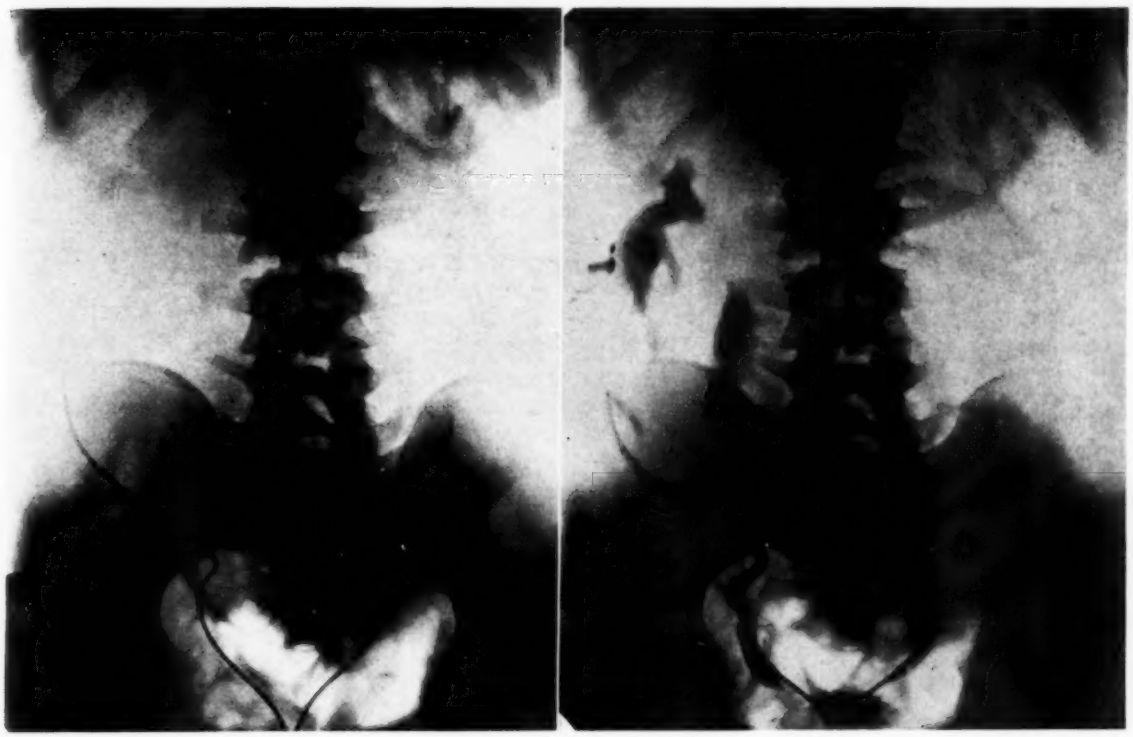

Fig. 4. Fig. 5.

Figs. 4 and 5. Case III.

Pyelograms showed the right kidney in the proper location but the left abnormally placed inferior to the right. In both rotation had been incomplete. The ureter from the ectopic kidney crossed the midline to enter the bladder at the normal location. (Fig. 3.)

This patient progressed favorably and was discharged, symptom free, on March 23, 1934.

Case III. This patient was admitted by Dr. H. M. McClure of Chickasha, to the Chickasha Hospital, with symptoms of acute pyelitis, right side, with sepsis.

On cystoscopy it was noted that the left catheter drained urine loaded with pus while the right one drained normal clear urine. Because of this, Dr. McClure suspected some abnormality and allowed the left catheter to remain in situ after pyelograms were made.

An *x*-ray with both catheters in place showed the left catheter passing to the right of the spinal column and stopping below the right. (Fig. 4.)

Pyelograms revealed the ectopic or left kidney inferior and slightly medial to a normally situated right kidney. (Fig. 5.) It should be noted that both pelves are abnormally rotated.

The left catheter draining the lower segment was left in for several days for lavage with a resultant rapid relief of symptoms. This patient was seen by one of us (Maj. B.) while the catheter was still in situ.

Dr. McClure reported several months later that the patient had made an uneventful recovery.

It can be noted from the pyelogram (Fig. 5) that the position of the two renal pelves is such that the fusion may be horseshoe in type rather than the tandem fusion of unilateral fused kidney. In any event it can still be classed as a unilateral fused kidney because both segments of the kidney are entirely on the right side of the spinal column. Our belief in the diagnosis of unilateral fused kidney is further borne out by the fact that the infection in this case followed the usual predilection for the lower segment or ectopic kidney.

We consider it a very rare accident that these three cases should have been seen in one year in a rather small urological clinic as we are running a general surgical service and what urology we do might be classified as a "side-line."

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NEW INSTRUMENTS

SURGICAL NEEDLE

J. L. Bubis, M.D.

CLEVELAND, OHIO

THERE has been a long felt need for a universal needle, that is one that separates the fibers of the tissues without cutting them and may at the same time be easily drawn throughout its whole length without jerks, undue resistance, or tension. Neither the cutting or sharp-edged needle, nor the so-called round needle can meet these requirements. We believe that the needle herein described will meet these specifications.

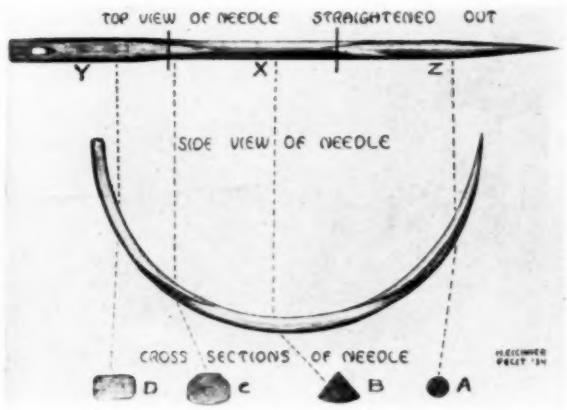


FIG. 1.

In the accompanying illustration this type of surgical needle is shown. It has been designed for use as a universal needle and has all the good points of the round needle plus the advantages of the cutting needle. It is especially suited for use in all puerperal gynecological operations.

In the top view of the needle, as it would appear if straightened out, it can be seen that the point (cross-section A) is round and gradually tapered to extend for about one-fourth the length of the needle. At

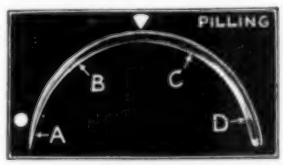


FIG. 2.

this point (cross-section B) the inner or top surface is sharpened so that a transverse section is practically triangular. This gives a cutting edge to the needle at a point where the diameter and resistance is greatest in the round needle. The transverse section at this point also shows the needle to be slightly less in diameter than the anterior or posterior sections, so that if the needle were divided into three sections, the middle portion being X, the anterior portion Z, and the posterior portion Y, the section X would be narrower than that of either of the other two. At cross-section C the needle is gradually tapered and at cross-section D has assumed the original form of the old style needles. The curve of the needle follows closely that of a regular curved needle, and can be made in any of the desired sizes.

Extensive experience with this needle has repeatedly proved that it is well adapted for use in any type of tissues.

NEW NEEDLE FOR THE INJECTION OF VARICOSE VEINS

F. M. Al Akl, M.D.

NEW YORK CITY

IN obliterating varicose veins by the injection method, the sclerosing solution is, in over twenty of the larger

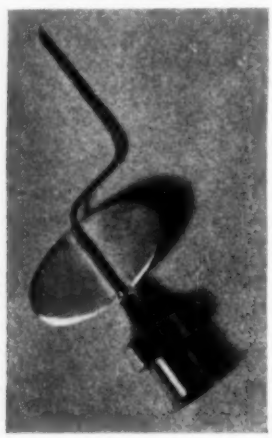


FIG. 1.

dispensaries in the metropolitan area, still being injected into the vein while the patient sits on a chair or is standing up. Except for the few instances where the vein is momentarily emptied by milking up the column of blood with the thumb of the one hand, the solution is introduced into a vein distended with its contents.

The advantages of injecting the solution into an empty vein are incontestably obvious. It stands to reason that when the sclerosing solution is introduced into a vein full of blood, the solution in mixing with the vein contents becomes diluted, and its action on the intima of the vessel is that much weaker. On the other hand, if the solution is injected into an empty vein, it comes in contact with the lining endothelium in full strength, starting a stronger irritation in a shorter period of time. The reaction that follows is consequently more vigorous, and the possibility of failure of eventual obliteration is as a result greatly diminished. Again when the solution is injected into a distended vein, the area of the vein wall affected by the solution is limited, and the

FIG. 2.

segment of the vein sclerosed is comparatively small, whereas a solution injected into an empty vein is bound to trickle down the vessel and result in the sclerosis of a longer segment of the vein.

In France, with these viewpoints in mind, clinicians use a tilting chair of the barber shop type. The needle is introduced into the lumen of the vein while the patient is sitting on the chair, and his leg hanging down. The chair is then tilted back, the leg support levelled and the vein injected. In order to work on a vein under the same favorable state of emptiness, without using a special chair, a needle has been devised to be used with the ordinary examination table found in the majority of clinics and private offices of physicians.

The needle is gauge 22, or any preferred gauge, with two angulations in its shaft and a flat oval revolving plate mounted on

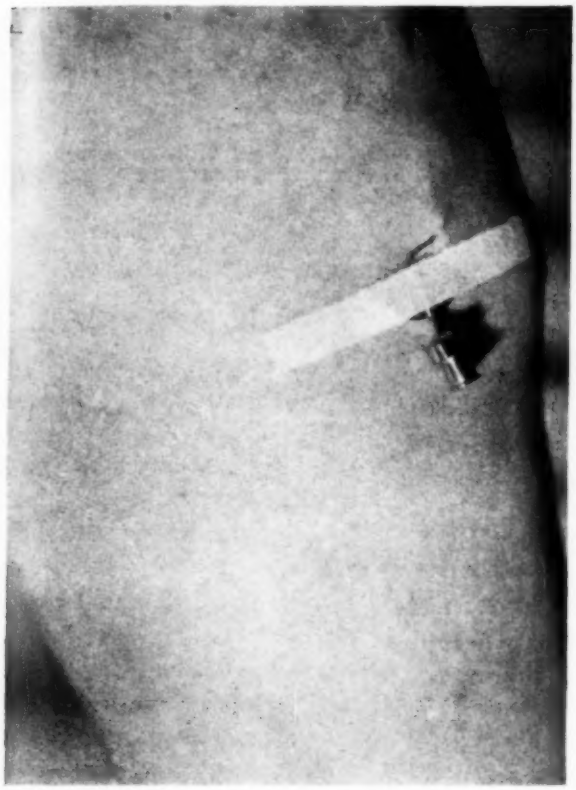


Fig. 3.

the shaft to the distal end of the hub (Fig. 1).

TECHNIQUE

With the patient sitting at the edge of the table (Fig. 2) the straight portion of the needle's shaft is introduced into the particular vein. After ascertaining that the needle is in the cavity of the vein as evidenced by the uninterrupted flow of blood, the portion of the needle outside the vein is rotated and made to rest on the surface of the leg. The plate of the needle, lying flat on the skin, is next secured in position by means of a narrow strip of adhesive plaster (Fig. 3). The patient is then instructed to lie down while the lower segment of the table is levelled, thus raising both legs. The leg to be injected is further elevated by resting its calf or heel on the knee rest of the corresponding side of the table. The leg is left in this position for the veins to drain, while the syringe and connecting rubber tube are assembled and filled with solution. The connecting rubber tube is attached to the needle, and the

Fig. 4.

empty vein is injected (Fig. 4). The needle is withdrawn after the injection, and a dry compress is secured in place by an adhesive strap. The leg is left in this position for five minutes after which time the patient is allowed to get up and walk.

In cases where the veins to be injected are located posteriorly, the needle is introduced while the patient stands up. The patient is then made to lie on the table face downwards, and the rest of the technique followed in the manner described before. The needle must be cleaned immediately after use, as the introduction of a wire into its hollow is not easy on account of the angulations in its shaft, in case it becomes clogged.

Because the injected fluid is not diluted by the blood in the vein before it comes in contact with the vein wall, the sclerosing solutions may be used in weaker concentrations to obtain the same results; with a broader margin of safety from toxic symptoms in susceptible individuals.

An added advantage to the use of this technique is that the same syringe may be used for treating more than one case. All that needs to be resterilized is the needle and the connecting rubber tube.

ROBERT KOCH

ROBERT KOCH was born on December 11, 1843 in Clausthal, Hannover. A precocious child (he read newspapers at the age of five), he attended the gymnasium, and entered Göttingen, from which he received his medical degree in 1866. While studying he was influenced by Jacob Henle, whose theory of contagion may have been the stimulus that started Koch on the path of his life's work.

Koch served in the Franco-Prussian war after which he became district physician at Wollstein. In 1867 he married Emmy Fraatz who bore him a daughter. His wife died a few years later. After Koch settled in Wollstein he married again and his second wife, on the occasion of his birthday, gave him a microscope. He began his researches with anthrax. In April, 1876, he wrote Frederick Cohn, at Breslau, to the effect that he had worked out the life-history and sporulation of the anthrax bacillus. He published (1877) his method of fixing and drying bacterial films on cover-slips; also, the method of staining them, of staining flagellae, and of photographing bacteria. In 1878 he published his epoch-making paper on the etiology of traumatic infectious diseases.

Through Cohnheim's influence Koch was appointed to a vacancy in the Imperial Health Department. Löffler and Gaffky were his assistants (1880). In 1881 he reported his method of obtaining pure cultures of organisms. The following year (1882) was memorable for his discovery of the tubercle bacillus by special culture and staining methods. His paper contained the first statements of "Koch's postulates." About this time he introduced steam sterilization by dry heat.

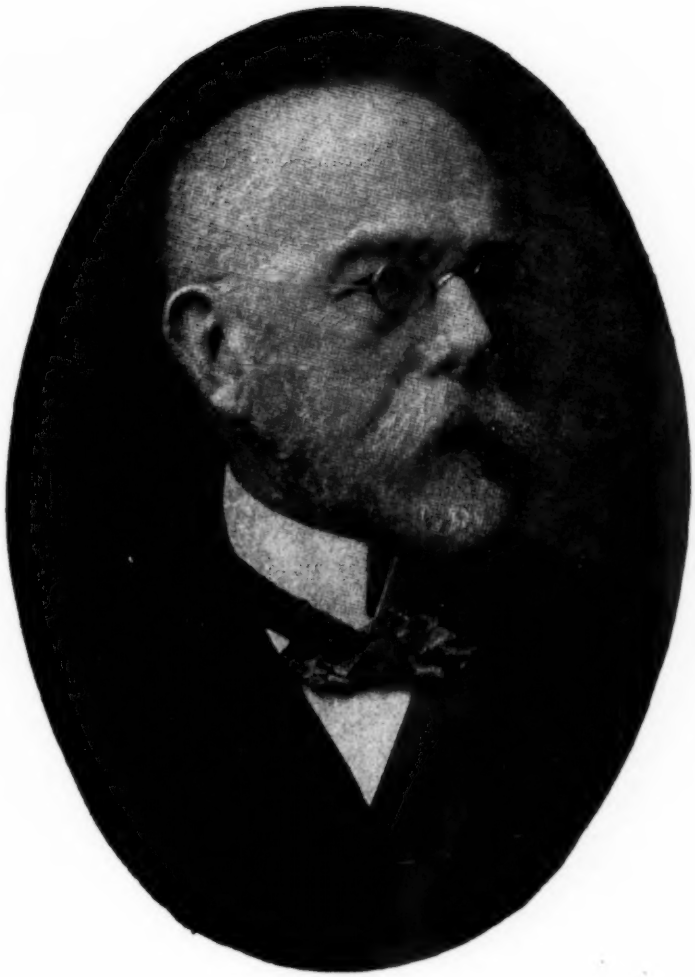
In 1883, Koch headed the German Cholera Commission. Egypt and India were visited and the discoveries of the cholera vibrio and its transmission were made. Also, the microörganisms causing Egyptian ophthalmia were identified. For these works he received 100,000 marks from the Prussian State.

In 1885 Koch was appointed professor of hygiene and bacteriology at the University of Berlin. Among his pupils were Gaffky, Löffler, Pfeiffer, Welch, and Kitasato. In 1890 he announced he had found a cure for tuberculosis, his one mistake. In 1891 he headed the newly founded Institute for Infectious Diseases. In 1894 he resigned in favor of his pupil, Gaffky. In 1893 he wrote an important article on the water-borne epidemics. Following this he investigated Rinderpest in South Africa, at the request of the British government, and discovered a method of preventive inoculation. In the following years his declaration that human and bovine tuberculosis were not identical, claiming that there is little or no danger of transmitting the bovine type of the disease to man, caused a world-wide controversy. In 1902 he established methods of controlling typhoid.

Koch received the Nobel Prize in 1905. In 1906 he again visited Africa and introduced atoxyl for sleeping sickness.

At the age of sixty-seven, May 27, 1910, Robert Koch died of heart-failure.

T. S. W.



ROBERT KOCH

[1843-1910]

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[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

DUPUYTREN*

WILLIAM M. MILLAR, M.D.

CINCINNATI, O.

THE Goddess of Choice and Chance plays her tricks everywhere and at all times but nowhere has she been more capricious than in the fields of surgery and medicine. Ever notorious for her tendency to overlook those individuals who deliberately set out to be numbered among the immortals she has been especially sparing when it comes to physicians. It is only at rare intervals that a doctor is permitted to contribute anything of permanent value to his own profession. That has been left for others. For example, it was a Dutch linen draper who perfected the microscope, an Austrian monk who changed all the existing ideas on genetics, and a French chemist who revolutionized the world of surgery with his ideas on bacteria. The Goddess would seem to relent occasionally and every now and then a doctor does become truly famous but only in another field or at best in one but distantly allied to his own. John Locke's philosophy has been discussed more than his chirurgical craft. Keats will be recalled far longer for his poetry than he will for his surgical dressings at Guy's Hospital, and while Copernicus and his work on astronomy have been remembered for generations the world has already forgotten that the old monk was also an excellent medical man. Lister only became immortal when he stepped out of ordinary surgery and became a practical bacteriologist, Helmholtz when he deserted the scalpel for the fascinating laws of sound, light, and thermodynamics. Such a list could be prolonged indefinitely. Still every now and then there appears on the surgical horizon some individual who has apparently succeeded in defying the chirurgical Nemesis, and such a man was Guillaume Dupuytren. All of his life this Frenchman deliberately sought fame and honor and at his death was considered and proclaimed one of the greatest men of his generation. But time has shown that the great Frenchman made two mistakes in his otherwise successful career which will keep him from being ranked with the truly famous. One was a sin of omission while the other was one of commission. The Frenchman reintroduced the "healing" of the sick by means of the "divine touch," and while head of his department of surgery in Paris failed to see and properly

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appreciate the cure and course of acute appendicitis when it was clearly and lucidly pointed out to him by one of his assistants.

An unusual man was Dupuytren—a gentleman who had as his motto: "I have been mistaken but I have been mistaken less than the other surgeons." Born in a tiny village in west-central France in the year 1777 he seemed destined from the beginning to have a peculiar career and an unusual life. It was an age of adventure, these times before and during the French Revolution, but no one of that period got away with a quicker start than this son of a provincial lawyer. Kidnapped at the age of three by a woman from Toulouse who fell in love with his blond hair "et sa physionomie pleine de grâce" the youngster was eventually rescued by his father after considerable difficulty. At the age of twelve the boy aroused the interest of a cavalry officer whose regiment happened to be stationed in the little town. So attracted was the soldier by the lad that the trooper offered to take him along to Paris when the squadron was moved on to another bivouac. To this idea the young Frenchman assented gladly. Apparently no family difficulty was encountered and the Advocat must have willingly assented for we next hear of the youth in a Parisian school which was conducted by M. Coësnon, a brother of the cavalryman.

At just what point in his life Dupuytren decided to become a surgeon is not known. Historians of the Horatio Alger school would have it that he had always wished and wanted to be one. Certainly the profession had nothing to recommend it in those days. No one who wanted really to be "somebody" would ever think of it. Medicine itself was only one step away from charlatanry. Mesmer was still alive and, of course, surgery had changed but little since the days of the master barber. The educated Frenchman of the time, when he was not embroiled in politics or world wars, was keenly interested in science and mathematics. Botany and comparative anatomy were accepted, a bit dubiously perhaps, but with interested men like Lamarck and Cuvier connected with them one could not afford to sneer too openly. Surgery was out of the question. The leaders of this trade (it was no profession) came without exception from the riffraff and the scum of the lower classes. There were no anesthetics in use and it was a hardy and stone-hearted individual who liked, dared, and kept on operating. Surgeons of the time were full of the blandness of ignorance. To be a leader one had only to be technically skillful, hard-boiled, and endowed with the real killer type of mind that nowadays has its personification in embryonic brain surgeons.

The French Revolution came and went but in spite of discouragement and poverty the young lad decided to go on with his chosen profession. This was an extraordinarily hard thing to do. The boy had no influence and no "pull," and no funds upon which to draw. His food allowance was always as meager as that of a hunted cat and at one time he lived for six weeks upon bread and cheese alone. The lad was so poor that in order to see to study at night he was compelled to burn cadaver fat in his oil lamp. It was only natural that pride and obstinancy would grow under such conditions. Saint Simon chanced to become acquainted with him at this time. The famous socialistic philosopher saw at once that the young student was literally starving. However, the older man did not dare to give or even offer to lend him money. Once the former did slip a couple of hundred francs into a skillet that was always depressingly bare and empty and left the room. In a short time the money was found by Dupuytren. Dressing hurriedly (he had probably gone to bed to keep warm) the youngster immediately sought out Simon, handed him the currency, and said: "Monsieur, you have lost this." The pride of the young man was only equalled by his brilliant ruthlessness and purposefulness. Always an incessant

worker the clever youth rapidly mounted the scholastic ladder.

He started the actual work of a medical student and soon, at the age of eighteen, he was appointed a "prosecteur" on a very meager salary. By 1801 the position of *chef des traveaux anatomiques* was obtained. From there his supple intellect turned toward physiology but this was only temporary for the 26th Fructitor of the year X saw him a surgeon of the second class at the Hôtel Dieu. Step by step, by hook or crook, and by every means possible the Frenchman advanced. Tied on one occasion for a hospital appointment with Roux who was his enemy socially and scholastically, Dupuytren is said to have won because the shrewd trickster had learned beforehand the nature of the question that was to be asked. With practically all of Europe at war and with almost every able-bodied man under arms the self-seeking doctor stayed on in Paris. The battlefields of the Palatinate or Spain were not for him if he could prevent it. He was no Larrey, a man who could combine surgery, adventure, and travel and who apparently had a most delightful and happy time doing all three. In 1808 (some say 1805) Dupuytren was drafted to the Colors. Wires were pulled and somehow the young surgeon managed to secure exemption chiefly, it would seem, because he prevailed upon the Hôtel Dieu authorities and the members of the Faculty to sign a petition to the government in which they stated that the young physician was indispensable to them.

Time passed and the young man finally came to be "second" in surgery. His chief was Pelletan, a lazy and apparently good-natured individual who soon had cause to fear and hate his truculent assistant who was ever putting his superior in the wrong and who was constantly bickering and squabbling with him. Just how many years this quarrel would have lasted is problematical as Pelletan was soon ousted from his position because he had the misfortune to kill a rather prominent patient. The details of the affair were essentially as follows: A Russian army officer was admitted to the Hospital with a swollen thigh. The soldier was acutely ill and his condition was diagnosed by the *Chef-de-Chirurgie* as an abscess in spite of the absence of fluctuation and other classical signs of the day. Pelletan operated and the extremity was opened but the iliac vessels were cut in making the incision! The resulting hemorrhage was tremendous and packs and tampons were ineffectual. Of equal lack of success were the "through-and-through" sutures that were drawn through skin and muscle in an effort to control the bleeding. No attempt was apparently made to isolate the bleeding vessels and ligate them separately; the patient was finally sent back to the ward in a profound shock and died in a few hours. There was nothing unusual in this for such a sequence had happened time and time again in Pelletan's operations but most of them had been poor, friendless wretches who had no one to aid them. This time conditions were different for unfortunately, for the Frenchman, the Russian had a number of influential friends and they proceeded to stir up a tremendous furor. They demanded immediate satisfaction and were able to bring so much political pressure to bear that the Operator was soon ousted from his position. Dupuytren who was next in line took his place. At last his dreams were fulfilled for he had become the leading man (at least in academic rank) of his profession. But like every self-centered individual who holds a quasi-political job he remained always in constant dread of dismissal. His toady-like conduct with the Bourbon Kings and his ever emphatic endorsement of his own superior qualities are an evidence of this. Mason Warren, a young American who was in France a few years later, said of him: "His operations are always brilliant and his diagnosis sometimes most extraordinary. He is one of the most suspicious persons I have ever encountered. He is continually seeking to convince us that he is a great man and that we do not suffi-

ciently value his talent. He likes very much to make a show and generally talks during the whole operation. . . . " As a superegotist this famous Frenchman takes his place with Napoleon, Voltaire, and Rousseau.

In his earlier days the young man apparently fell in love. At least the "up and coming" surgeon became engaged to a charming young French girl. The date of the wedding was set, the invitations issued and everyone was prepared for the gala affair when suddenly the engagement was "off." Opinion varies as to which of the parties was responsible. It was too late to cancel the arrangements and with the typical Gaelic dramatic touch the bride's father allowed all of the guests to assemble and then read a letter, purported to come from Dupuytren, which broke off the affair. When the note was read the old gentleman went into a most invective speech and proceeded to tell the assembly what a lucky child his daughter had been and how fortunate she had been to escape from the marital embraces of such an unmentionable individual. The air sang with his adjectives and his opinion of the erstwhile bridegroom. When he was through, all breathless and hot with indignation, the feast commenced and lasted throughout the night, a wedding party metamorphosed into a banquet of happy deliverance. In passing one cannot help wondering where Dupuytren spent that night. Was the ex-lover in an autopsy room or bending over his table sweating away over some old surgical work? At any rate this self-centered individual was not one to waste his time nursing a broken, love-stricken heart, for his passion in life was surgery and he had to go on and ever learn more and more about it. To him a scalpel was a much prettier thing than a bride's hand, and an autopsy table a much more satisfying affair than a nuptial couch. Nothing could or should interfere with his surgery which after all was probably the only thing that this really famous man really loved. Later in life the Frenchman did marry some one else but common gossip would have it that the Dupuytren home was the unhappiest in Paris. One daughter at least resulted from this luckless union for we find mention of her in a letter written by the Master Surgeon to King Charles. But whether there was any really true bond of sympathy between the child and her father in any way comparable to Lamarck and Cornelie is not known. It is likely that there was not. Love did not seem to be one of this savage, eccentric man's strong points.

Time passed and with each year the choleric Parisian grew more and more famous, and if possible, more and more busy, and there came a time when he was treating all the nobility of his own and most of the famous men of other countries. The Frenchman was supposed to have had as many as ten thousand private patients a year.

The Master of the Hôtel Dieu was an incessant worker and drove himself and his assistants along at a great pace. Like Buffon he arose at five in the morning but, unlike this scientist, Dupuytren did not seem to require any valet to pull him out of bed and hound him into activity. Of a remarkable strong physique, his manner was restless, impatient and choleric. His eyes were piercing and generally contemptuous and his mouth had none of the peace of God upon it. The most striking part about him was his utter sloppiness. From all descriptions he must have been one of the dirtiest Barons that France has ever produced! He usually wore a long green coat that always seemed to be streaked with grease and food stains. His boots were always mud-spattered and over the top of them would peep a pair of villainously dirty socks.

As chief surgeon this uncouth physician had theoretical charge of all of the surgical cases in the Hôtel Dieu (over 300) but as a matter of fact only 113 beds were kept under his personal observation. The rest were relegated to two of his assistants. Every morning from six to nine the magnif-

icent teacher would make it a point to see every one of his patients. A swarm of doctors and students would trail along behind him, enthusiastically but nevertheless a bit warily, for it was well known that the proud, egotistic man had once slapped an over-eager American who had happened to bump into him. With rounds finished the group would proceed to the operating pavilion where operations of all kinds and descriptions would be attempted and these without anesthetic, and no adequate means of stopping hemorrhage, must have been gory affairs. Glands of the neck, resections of the shoulder, the hip, were all done in a few minutes. A student clinic, at which a dozen or more cases of all varieties would be shown, sometimes followed this hecatomb. Here Dupuytren's white hot mind would be at its best. With one look at the patient he would make a diagnosis and then point out the reasons for arriving at such a conclusion. His remarks were as piercing as they were tactless. He thought little or nothing of the patients or of their feelings and he was so brutal that his patients frequently fainted. But was he not the great Dupuytren? They should be very, very glad that the great one would even deign to look at them. The morning hours would rush by and noon would generally find him somewhere on the wards. With him lunch time was no time for gentle conversation and small talk at a cafe, for this surgical savage would gnaw away at a crust as he went stamping along the corridor. As we said before this great clinician made it a point to stop at every bed and to see all his patients personally. On one occasion the group came to the side of a country curé. Dupuytren shot him one of his piercing looks, roughly grabbed his neck and probed heavily into a great mass of ulcerating glands. The man involuntarily flinched. A cold sneer, "You will die, Priest, I can do nothing for you!" There was no answer, no protest. The man seemed unaffected by this brutal announcement and murmured gently more to himself than to those around him that his fate was in God's hands. Such an exhibition of nonchalance and courage at once affected the volatile, changeable Frenchman. Again he touched the repulsive growth, but this time he palpated and examined with much more gentleness. Finally he spoke in a softer voice: "You are a brave man, Father. We will operate tomorrow." They did so and the Priest recovered and in a few weeks the patient departed for his country parish there to remain a grateful friend of Dupuytren and one who never failed to sing his praises. This individual was one of the few (many have spitefully said the only sincere) friends that Dupuytren ever had.

There are at least two stories of his work at the operating table that are worth relating. J. M. Warren tells of watching the great man operate for an inguinal hernia. The second swoop of the knife ripped into the bowel and feces poured out from the gut into the incision. Dupuytren raised his scalpel dripping with red and brown and quietly said as he looked up at the spectators, "Messieurs, la matière fecale," and with utter nonchalance proceded to sew up the wound. On another occasion this clever surgeon was dissecting out the enlarged neck glands of a young girl. The knife sliced and slipped around the masses with lightning rapidity. All at once a continuous, hissing noise was heard. The patient gave a gasp or two and died. The spectators were thunder struck for this was hard luck even for a French doctor of that callous and indifferent period. Perplexity was written over Dupuytren's face. The operator took up the forceps and the probe again and peered into the V incision. Suddenly a gleam of understanding flashed over him. The chief looked up to the bystanders and then pointed to a large vessel which had been partly severed and which still gaped open. This had aspirated the air which had been the reason for the unusual noise, and the fatal outcome had been due to air embolism.

Dupuytren, like his contemporaneous confreres, had numerous operative deaths on the table such as the one described

above. Yet, though these together with erysipelas, tetanus, and "hospital fever" took a heavy toll, he is said really to have had excellent mortality statistics for his time. If we are to believe two of his students, de Boismont and Marx, in the year 1818 he performed some 368 operations with 228 recoveries. One hundred and seventy-eight fractures were set and three hundred abscesses were incised and drained in that period.*

The afternoons were spent in private practice and many amusing stories are told about the great man's relations with his patients. On one occasion an English lord came for a consultation and when Dupuytren was finished with the examination the Britisher quite absent-mindedly commenced to walk out of the office. The door was reached when he was stopped by the porter. (There was a set of signals between the master and the concierge for just such cases!) "Pay?" Certainly, of course he would. The Englishman fumbled for his wallet but could not find it and to his utter mortification found himself without a sou. Blushing the patient declared that the money would be sent. At this moment the "greatest Surgeon in France" rushed up and a violent squabble followed. Finally it was decided that the patient should leave his gold watch for security until he returned with or sent back the proper fee. With many incidents similar to this related about Dupuytren it is not surprising that the Frenchman amassed a great fortune. With his peasant's cunning he sought out one of the Rothschilds (who happened to be a patient) and together the two men made many profitable investments. And as though this was not enough he allowed the greatest surgeon's name in France to be used for an itch remedy and a hair grower upon payment of a considerable amount of money!

The "Napoleon of Surgery" had no real hobbies for his profound devotion to his profession would allow none. This eccentric genius even spent his evenings at the Hospital. One cannot help wondering what he did for his patients beside employing "emmolients," leeches, and stupes, and one cannot help feeling how fascinating this master surgeon would have found our twentieth century medicine with its post-operative therapy of blood transfusions, vaccines, and sterilized dressings.

Occasionally Dupuytren could be persuaded to take a night off and the surgeon would generally go to a cafe and indulge in some mild gambling. The Master of the Hôtel Dieu was a hard loser at this as in everything else, so much so, that it was a standard joke among his students that they would always know from the state of his temper on the next day whether the chief had won or lost!

The bold operator was in charge of the then famous DuBerry case and his treatment here gives us an idea of his surgical courage. This unfortunate nobleman, a relative of the Emperor, had been stabbed by an assassin who left a long knife sticking into his chest. Immediately some witless but well-meaning soul pulled out the blade and from the narrow hole blood came pouring out at a fearful rate. This could not be controlled either by packing or compression and when Dupuytren arrived he saw that the only chance of recovery lay in ligating the bleeding points at the base of the wound. At once he decided to operate and proceeded to lay bare the heart. It was his intention to suture its muscle but the luckless patient expired just at this point. Carping critics made much of this procedure for to them it was a useless piece of work. But the operator was sustained in his policy by his King who shortly afterward appointed him one of his attending physicians.

This great teacher of surgery wrote but little himself for a favorite aphorism of his was "Peu lire, beaucoup voir, et beaucoup faire." But the Frenchman's works have been collected by his pupils

* This is a tremendous number when one realizes, for example, that in the ten years preceding the discovery of anesthesia (i.e. 1836–46) only 385 operations, or an average of thirty-eight a year, were done in the Massachusetts General (Boston) Hospital.

and have been published in various languages and have gone through a number of editions. The choleric Baron's contribution to surgery was really extensive. He was the first to excise entirely the lower jaw, he advocated compression in aneurysm, was able to ligate the external iliac once and the subclavian twice. The master craftsman did a complete thyroidectomy, advised amputation of the cervix for carcinoma, and his treatise on contracture of the hand and his work on fractures of the lower leg still bear his name. There are clamps and even a stitch called after him. This eccentric savage, in addition, did excellent work in gross pathology and endeavored to see every autopsy. Space will not permit us to describe any of his operative procedures. But one of his often quoted works (though seldom read) is his essay, "Abscess on the Right Iliac Fossa." Here the surgeon pathologist asks why this condition appears to be intimately connected with the walls of the cecum. The master of the Hôtel Dieu procedes to answer his own question by stating that it was due to "an anatomical arrangement of part; and it will be seen that, on the right, the cecum, free from peritoneal covering behind, offers less resistance to the pressure of the pus, and that its thin, wasted ulcerated parietes must readily give away." The Frenchman goes on to describe the appearance of these tumors, that seemed to come on in

> . . . constipation, or diarrhea, or colic, habitual or otherwise; at other times, without any of these premonitary symptoms, the patient has violent colic and pain in the bowels which tend to a concentration in the right iliac fossa and they may also take the course of the large intestine, or spread over the whole of the abdomen. These attacks of colic are generally accompanied by constipation, and more rarely by vomiting. Such are the indications of the first appearance of the tumor. The duration of these premonitory symptoms is very various; some persons have these six to eight weeks, or more, whilst others experience them only for a few days before inflammation takes place. It will be understood, of course, that these symptoms are only of relative importance as they frequently occur in persons without any tumor forming. . . .
>
> The distinguishing symptoms of the disease are, the persistence of pain at some particular part of the iliac fossa and a swelling at this point. On feeling this part it is found to offer resistance and to be in a state of tension and a tumour may very often be detected, of considerable hardness, more sensitive to the touch than any other part of the abdomen and appearing to rest on the cecum. . . .

Dupuytren goes on to say that the predisposing conditions appear to be of various kinds: that men are more prone to the condition than women, that 11 of 16 patients were under thirty years of age. The season was of no great importance although "at the end of summer or the beginning of autumn abdominal disturbances are the most frequent; and this would tend to support the opinion of those who believe in the pre-existence of some lesion in the mucous membrane [typhoid?]." The cause: "house painters, color grinders, brass turners, have colics and may after a while get this tumour" [Lead colic?]. "Many students have also been affected in the same manner, after great disturbance in the digestive function. . . . " The treatment is purgative medicines (!) and on occasion rupture may occur into the intestine, the vagina, or the bladder. A case of a white man aged forty-five is cited who had a perforation of the cecal appendix with an external communication by means of a fistula with the right iliac fossa which was incised three times. The man died and pulmonary tuberculosis was found. In closing "Inflammation and the diseases of the cecal appendix, of which I have seen many cases have scarcely been noticed by authorities but Doctor Mélier, one of my pupils, has written a remarkable work on the subject. . . . "

Just what was it that Mélier had written? In the now almost forgotten volume of the *Journal Général de Médecin* for 1827 this twenty-nine year old physician collected 7 cases extending over a short

period of time. He pointed out a definite relation between the ruptured appendix and the subsequent death from peritonitis. He formulated a conclusion that the chronic cases (as Dupuytren described above) have their onset from the acute. A possibility of surgical intervention as a means of relief was even suggested. Mélier's work was well done. But the leading surgical man in France declared that the young man was wrong or at best only partially right. And so it happened that Mélier was dead some twenty years (he lived long enough to have a couple of excellent French eulogies over his grave, too) and his master and chief, the Baron, had been gone some sixty odd before the whole affair of appendicitis was finally straightened out by the American, Reginald Fitz. While this story of appendicitis was a sad one and a black mark for surgical history, Dupuytren was to commit a worse offense against surgery for he deliberately revived, in order to cater to the vanity of his King, a custom and a therapeutic measure he must have known was both wrong and ineffectual. When Louis died his brother, Charles x, came to the throne. The coronation at Reims was carried out with all the pomp and heraldry possible, and as a fitting climax to this glorious ascension of "His Most Christian King" the newly created Baron (he had only been numbered among the aristocracy now for some eight years) and his medical confrere, Alibert, brought up 121 cases to be healed and cured by his Majesty's "Divine Touch." This quaint property, as one may recall, belonged only to certain properly selected kings and was based on the premise that God and His Majesty were ever in "cahoots" and that as a King was really a symbol of the power of the Former he was able to heal by the "laying on of hands." (Charles also made the sign of the cross on the patient's forehead.) With the advent of the nineteenth century this custom had fallen into complete desuetude. Whether this was due to the increase in the number of skeptical Republicans, the dearth of gold or silver pieces that had always to accompany the procedure, or the scarcity of five year cures is not known. At any rate the revival of the ceremony was a truly autocratic gesture. It is inconceivable that a man of Dupuytren's intelligence really believed in the ritual. He had merely thought of his position at the Hôtel Dieu, of his chance to hobnobb with the great and his practice with the royalty. Perhaps, too, this shrewd individual was cynical enough to realize that such a gesture would certainly do people no harm, and that it would be equal to, if not better than, the accepted therapy of the time.

The erstwhile starving student would find a more practical means of serving his Lord and Emperor. Charles Bourbon, ever a wastrel and a spendthrift, was eternally "broke" and so his loyal surgical Baron offered to lend him one-third of his personal fortune. The rest, the surgeon explained in a letter to His Majesty, would be retained for his daughter and for research endowment. The gesture was refused with thanks and doubtless a moue of regret for it was inconceivable that a divinely appointed Bourbon could take money or be treated as an equal by an eight year Baron and a man whose dealings with the tailors appeared only to be but bi-annual at best.

The Revolution of 1830 came and with it the "Three Glorious Days." This time it must be admitted that the canny egotist did not flee and seek to escape. He is said to have been in the thick of the fighting and to have taken charge of the first aid stations immediately back of the cobblestone barricades.

On the fifteenth of November, 1834, Dupuytren was walking across the Pont Neuf on the way to his beloved Hôtel Dieu when he suddenly staggered and almost fell. Fiercely the sick man pulled himself together and fought his way to the Clinic. Gamely the teacher tried to carry on with the morning's work. His

energy was gone and he felt tired and listless. The students noticed at once that the Baron could talk only with difficulty. "The old man is slipping," they whispered. His assistants were secretly pleased. With the Chief out of the way promotion would come. After all, Dupuytren had been "number one" now for almost twenty years and it was really time, they thought, for some one else to have a chance. He was put to bed, bled and treated until finally the great physician became so much better that his acquaintances suggested that he should go south to Italy. Here there would be no long harsh winter with its constant threat of pneumonia. Against his wishes the sick man left on his first real vacation. The reception received en route must have been a surprise for even this mightiest of super-egotists. Everywhere the crowds turned out to do him honor and at every village there were hundreds to cheer him on his way. The medical men of every city sought his acquaintance. Compliments flew. Finally Dupuytren came to the town where it had been decided that he should convalesce. After a few days of idleness in the sun he began to be restless, and the patient's thoughts went constantly back to the Hospital and to his work. Repose and tranquility were foreign to the Frenchman's nature. The tireless worker had known no rest in over fifty years and there was no reason why he should become acquainted with such things at this late date. We have a record of his conversation with Esquirol in Rome:

"Que vous presse?" lui demande Esquirol.

"Je songe à l'Hôtel Dieu," réspond Dupuytren.

"Vous l'avez laissé dans d'habiles mains."

"Oui, mais mon devoir?"

And return he did. The Master's first "home-coming" lecture was brilliant and those who listened said that it was one of the best that he had ever given. Ward rounds were resumed with vigor, but as one physician dryly remarked, "The volcano was burned out," and the *Chef-de-Chirurgie* was soon on his back with pneumonia. Empyema rapidly developed and with great interest the dying man watched the outcome. He refused tapping saying, "Je sais que je dois mourir; autant que cela arrive par la maladie que par l'operation." Directions were given for his autopsy. Slowly he sank. One day the door of his room opened and in walked the country priest upon whom Dupuytren had operated many years before. (By this time the news of the great man's illness had spread throughout France.) It is said that the Curé stayed on with his benefactor, gave him the final rites of the Church and remained with him to the very end. On February 8, 1835, the most famous surgeon of the world was dead.

The funeral was worthy of an emperor and was one which the late super-egotist would have heartily approved. All Paris turned out to do the cortege honor and the streets were lined by thousands. The procession had just gotten under way when the students impetuously rushed forward, loosened the horses and drew the hearse along to the grave. They had suddenly realized that the time would come when they would be proud to boast that they had worked with such a man.

The students were right for soon the pettiness, the meanness, the chicanery, and bitterness of Dupuytren's character were forgotten. France and the world have chosen to remember him only as a great teacher and a magnificent surgeon.

BOOK REVIEWS

VISCERITI E PERIVISCERITI; DIGESTIVE ABDOMINALI CHRONICHE. By Francesco Zagarese, M.D. Bologna, Nicola Zanichelli, 1934.

This monograph describes in detail the various theories of the formation of perivisceral membranes, adhesions and bands, as we encounter them in operations upon intra-abdominal pathological conditions. The author leans more towards the inflammation theory, claiming that these membranes are caused by the perivisceral reaction due to chronic visceritis, viz: chronic appendicitis, chronic cholecystitis, chronic gastroduodenal ulcers and chronic colitis. The chapter on the surgical pathology of visceritis and perivisceritis is well worth reading and studying. The sections on symptoms, radiology, medical and surgical treatment are well written and scientifically treated.

This book sums up in one volume of 360 pages what has been said and written in the past and present on this important and interesting surgical topic. The author is to be commended for his thoroughness, clarity and modesty.

SYNOPSIS OF GENITOURINARY DISEASES. By Austin I. Dodson, M.D. St. Louis, C. V. Mosby Co., 1934.

This book is just what its title implies, a synopsis of the complete subject of genitourinary diseases. It is accompanied by 111 well-selected illustrations. For a quick reference work, it will answer a certain purpose but for definite information it will be necessary to consult a larger book.

CATARACT: ITS ETIOLOGY AND TREATMENT. By Clyde A. Clapp, M.D. Phila., Lea & Febiger, 1934.

This book of 254 pages covers the subject of cataract very thoroughly. It is up-to-date, authoritative and has a bibliography at the end of each chapter. There are 92 illustrations and those doing cataract operations will find this work indispensable.

AMEBIASIS AND AMEBIC DYSENTERY. By Charles F. Craig, M.D. Springfield, Ill. Charles C. Thomas Co., 1934.

The large number of current cases of amebic dysentery render this book particularly timely. Dr. Craig has been studying this subject for many years and his work is thoroughly up-to-date and authoritative. As so many cases have been cropping up in different parts of the country, it would be well if this book were available at all times for quick reference.

MOTHERS' GUIDE WHEN SICKNESS COMES. By Roger H. Dennett, M.D., and Edward T. Wilkes, M.D. Garden City, N. Y., Doubleday, Doran & Co., 1934.

According to the authors, this book is intended as an "aid to the doctor in helping in carrying out of his orders." There is no question but that if mothers will really read and study this book it will be found of great service to both the doctors and themselves. It explains conditions in a way that should make for better cooperation between mothers and doctors rather than, as has been the tendency of these books in the past, attempting to replace the doctor's services. It is a book that may well be recommended to intelligent mothers.

TUBERCULOSIS OF THE LYMPHATIC SYSTEM. By Richard H. Miller, M.D. N. Y., The Macmillan Co., 1934.

This work on Tuberculosis of the Lymphatic System starts with an historical introduction and finishes with a general summary covering in less than 250 pages the high spots of this subject which are of the utmost importance to surgeons. It is a monograph of a type of which it is impossible to have too many in our medical literature. The author explains in his Preface that his experience has been "not in the laboratory, but at the bedside and in the Clinic." His point of attack is, therefore, just that which the practicing surgeon needs.

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